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AN ECOLOGICAL SURVEY OF THE PROPOSED CEDAR BASIN RESEARCH NATURAL AREA, SHASTA-TRINITY NATIONAL FOREST, CALIFORNIA

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INTRODUCTION

Location and Principal Distinguishing Features 3

History of Scientific Interest 5

JUSTIFICATIONS

The Port Orford Cedar of Cedar Basin 6

The significance of the inland POC population 6

Endemic and Unusual Klamath and Trinity Mountains Flora 10

Unusual Bog Species 13

The High Diversity of Ericaceae 15

Zoological Justification 15

PHYSICAL FEATURES

Geomorphology and Topography 16

Geology 18

Climate 19

VEGETATION

Shallow Lakes and Ponds 20

Bog and Meadow 20

Port Orford Cedar Forest 24

Mixed Conifer Forest 31

Red Fir-Mountain Hemlock Forest 36

Mountain Chaparral 39

Rock Outcrop 41

BOUNDARIES 44

IMPACTS 45

RECOMMENDATIONS 47

LITERATURE CITED 48

APPENDIX

Vascular Plant List 50

Vertebrates Known or Suspected from Cedar Basin 57

Vegetation Plot Descriptions 62

Description of Arctostaphylos klamathensis Edwards 76

INTRODUCTION

Location and Principal Distinguishing Features:

The Cedar Basin candidate RNA covers approximately 874 acres of red fir-mountain hemlock, mixed conifer, and Port Orford cedar forest with additional mountain chaparral, rock outcrop, lake, bog, and meadow communities in the northern Trinity Mountains of northwestern California.

The proposed RNA is on the Shasta-Trinity National Forest in extreme south-central Siskiyou County. It lies within portions of sections 25 and 36 of Township 39 North, Range 6 West, and sections 30 and 31 of T 39 N, R 5 W. Elevations range from ca. 5420 to 7149 feet. (see map 1).

The area is about 12 road miles west of Mt. Shasta City and may be approached to within a quarter mile by a good, oiled road (40N26). A poorly maintained jeep road(39N05Y) leads south off this road ca. one mile to Cedar Lake, inside the proposed boundaries.

Cedar Basin contains the highest elevation stands of Chamaecyparis lawsoniana (Port Orford cedar). This species is also near the eastern limit of its range here. The trees form a dense forest around lakes, seeps, and streams up to almost 6400ft. For several ecological, phytogeographical, and genetic reasons these stands are unique and promise to be the subject of much future research.

Also contained within this small basin are two highly restricted species of plants, a manzanita, Arctostaphylos klamathensis and a penstemon, Penstemon sp. nov. (as yet not formally described), which so far appear to be totally restricted to the basin. Several other species endemic to the Klamath Province also occur here.

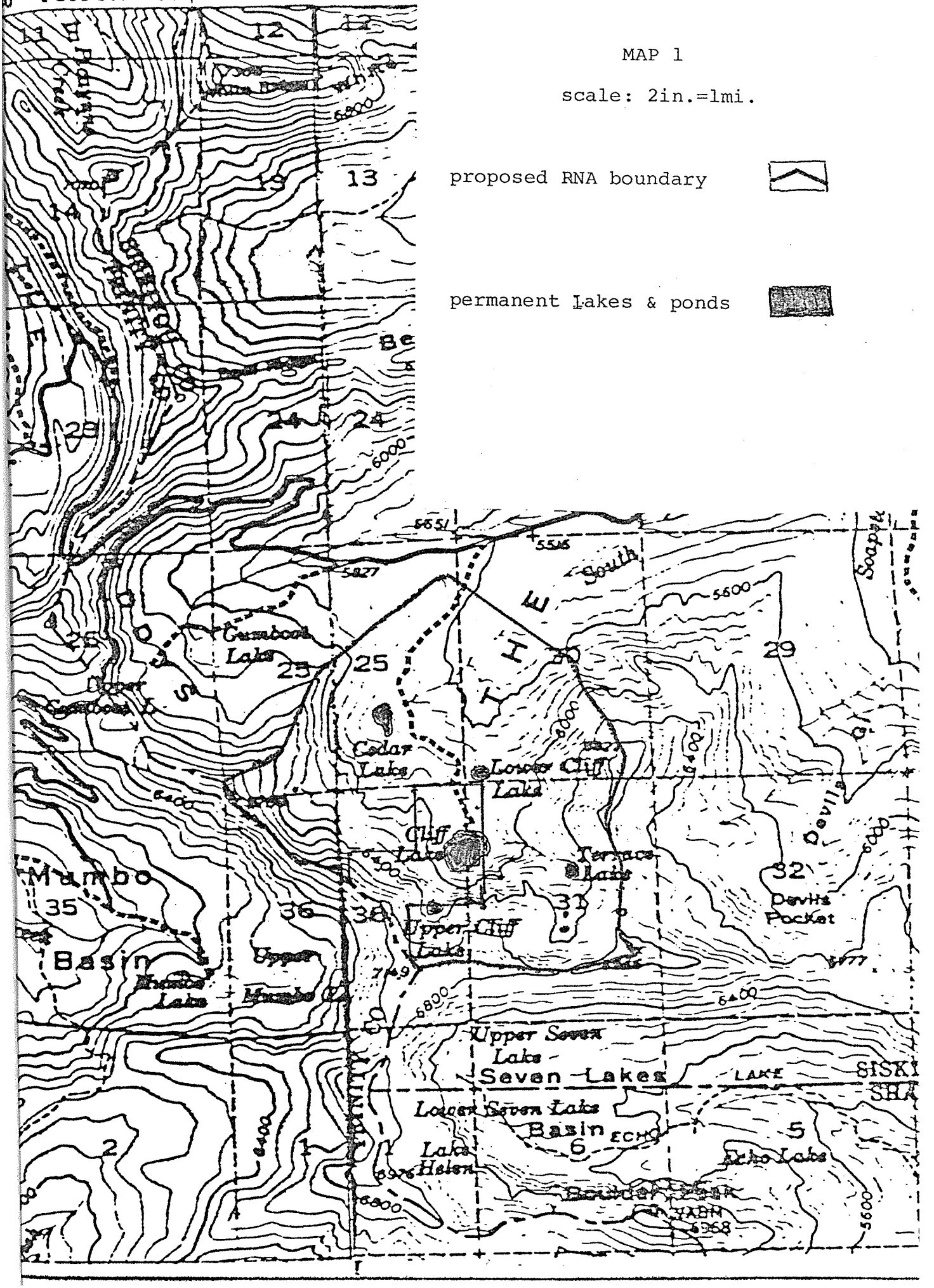
Another botanical value of the area is the bog vegetation around

MAP 1

scale: 2in.=1mi.

proposed RNA boundary

permanent Lakes & ponds



Cedar and Lower Cliff lakes. These bogs contain several rare and unusual species including Drosera rotundifolia, Darlingtonia californica, and Menyanthes trifoliata. Within the bogs and in adjacent forests and mountain chaparral no less than nine genera and 13 species of Ericaceae (the Heath family) occur, an extremely high concentration for such a small area.

History of Scientific Interest:

Cedar Basin has been the subject of botanical interest for several years. The California Native Plant Society has made two trips to the area (July 1981, Oct. 1982) to investigate the bog and lower basin flora, and more recently the new species of manzanita. Mary Taylor, assistant Shasta-Trinity N.F. botanist, also collected twice in the lower portion of the basin in 1980. John Sawyer of Humboldt State University visited the area in 1980, and Glen Keator of the Strybing Arboretum has collected in the basin.

In June 1976 the University of California Santa Cruz California Natural History Class spent three days studying various aspects of the ecology of the basin.

Apart from the visits actually made to the area, numerous other researchers have expressed interest in preserving the basin,primarily because of its high elevation, inland stands of Port Orford cedar (POC) and because of the potential genetic differences between these and the coastal stands of the species. These researchers include Drs. Adams, Hawk, Roth, and Zobel who have studied the ecology of POC and consider the area as a valuable genetic resource as well as a protected bastion against the rapidly spreading and lethal cedar root rot, presently inflicting a great deal of damage on the coastal POC populations.

JUSTIFICATIONS

The Port Orford Cedar of Cedar Basin:

Of primary importance to foresters are the basin's stands of POC, for which the area receives its name. These stands are not only the highest elevation of any POC groves in the species' natural range (Steven Edwards, pers. comm.), but also are near the species' easternmost range limit (about 10 miles east along the upper Sacramento River).

POC has a limited natural range centered in the Klamath Province of Southwestern Oregon and Northwestern California. Most of the range is coastal. However,a distinct inland population separated from the coastal stands by about 50-60 miles occurs along the upper reaches of thr Trinity, East Fork of the Trinity, and Sacramento River drainages (Griffin and Critchfield, 1972). At present no established RNA's within the R5 region include extensive stands of POC, and only one other candidate RNA (Adorni, within the main coastal population) is being considered. Cedar Basin is the first candidate RNA within the species' inland distribution.

The species, because of its limited range, high economic value, and extremely threatened nature due to the rapidly spreading root rot fungus, has been considered by Dr. Peter Theisen, R6 regional geneticist,as the single most important tree species within the region to study and preserve (fide Ron Kelly).

The significance of the inland POC population:

Raven and Axelrod (1978) consider POC to be a species that is somewhat restricted to serpentine and other ultramafic soils. Griffin and Critchfield (1972) note that particularly farther inland POC appears more restricted to serpentine soils. In the most recent

review of the species' ecology (Zobel and Hawk, 1980) POC is not considered to be strongly restricted to ultramafics on any part of its range and Zobel and Hawk state a high water table (permanent moisture) as a more important limit to its distribution. Despite this, when a map of the species' range (Griffin and Critchfield, 1972) is compared to a map of the ultramafic outcrops in the Klamath Province (Irwin, 1966) the main coastal and inland populations coincide almost exactly with the two largest ultramafic exposures in the region. The inland distribution lies almost entirely on the Trinity Pluton, a huge sheet-like exposure of primarily serpentinite and gabbroic rocks with a continuous western boundary 100 mi. long (Davis 1966, Irwin 1966). There is no accurate date to my knowledge for the time of exposure of this sheet. However, it is clear from fossil evidence (Raven and Axelrod, 1978) that POC had a much wider distribution off of ultramafics in the mid Tertiary (to at least E. Oregon, W. Nevada, and S. Idaho). The present inland restriction to the serpentine belt probably occurred in the late Pliocene or early Pleistocene coinciding with increased erosional processes exposing subjacent rocks (such as the ultramafics) in the Klamaths (Diller 1902, Irwin 1966) and the continual drying of the western U.S. climate during the uplift of the cordilleran mountains, forcing the species to move westward (Raven and Axelrod, 1978). Thus, the inland stands have probably been isolated for at least one million years.

Zobel and Hawk (1980) have shown that a sample stand of POC within the inland distribution (Castle Lake ca. 6 mi. NE of the basin and several hundred feet lower in elevation) 1) had the shortest growing season, 2) the lowest mean annual soil temperature, 3) the lowest mean annual air temperature, 4) the coldest cold month annually, 5) both the lowest and the highest annual Temperature Growth Index (lowest in winter, highest in summer), and 6) the lowest temperature

recorded at any of their sites during the study (3°F).

Because of the long-term isolation in a colder, more extreme climate the likelihood of genetic differentiation in the inland populations is relatively high. This differentiation could be significant in the maintenance of viable POC reserves in a number of ways. It has been suggested (Donald Zobel, Lewis Roth, in lit.) that the inland high elevation stands may even prove to be resistant to the devastating Phytophthora root rot. Evidence from other commercially important species such as the avocado (from research conducted by Dr. Zentmire of U.C. Riverside fide Ron Kelly) suggest that isolated montane stock (in this case from Central Mexico) is the most root rot resistant form yet discovered.

Regardless of possible genetic differences from the main coastal population, stands such as at Cedar Basin represent easily preserved and controlled sites which could be protected from root rot infestation if the proper precautions are taken. For a review of the necessary precautions see Kliejunas and Adams (1980). According to recent studies (Kliejunas and Adams 1980, Zoebel and Hawk 1980) and testamony from other workers (in lit.), the non-native Phytophthora lateralis has, and will probably continue to spread rapidly from Oregon (via root stock imported to British Columbia from France in 1923) throughout the range of POC. It inevitably kills both large old growth trees and saplings before they reach marketable size. It is easily spread from drainage to drainage in mud transported on tires and fenders of cars and trucks. Fortunately at this time the root rot has apparently not spread to any part of the inland population. Clearly, a well controlled and geographically well contained area is necessary for the preservation of uninfected trees. An area such as Cedar Basin at the head of a river drainage in an uninfected region, with only

one little-traveled road leading into the area would be easily managed for root rot exclusion. With the current value of POC over $3000/MBF there are definite economic as well as scientific and esthetic justifications for maintaining healthy populations of this species.

There may be horticultural as well as silvicultural research values for the high elevation inland population of POC. Chamaecyparis lawsoniana is one of the most widely planted ornamental conifers in the North Temperate Zone. Bailey (1978) states that over 80 horticultural "varieties" have been developed in Europe and North America. Many or all of these have originated from the main coastal population and little or no breeding research on the inland population has been conducted. Again, with the distinct climate and long isolation of the inland stands, it is likely that different genetic tolerances to environment as well as possible morphological differences in foliage and stature, may serve to increase the species' ornimental value.

From a more ecological standpoint, the Cedar Basin POC is unique with regard to its associated flora. Only in this and perhaps in one or two other high elevation basins in the Trinity Mountains, does POC associate so closely with typical high montane trees such as Abies magnifica, Pinus contorta, P. monticola, and Tsuga mertensiana. In some areas as in the Terrace Lake cirque, all four of these species may co-occur with C. lawsoniana (see vegetation section). Zobel and Hawk (1980) state POC is remarkable for its restricted geographic range yet its extreme tolerance of a wide range of habitats, spanning four vegetation zones as defined by Franklin and Dyrness (1973). Actually, the Cedar Basin stands clearly extend into a fifth vegetation zone (the Abies magnifica shastensis zone) and marginally into a sixth (the Tsuga mertensiana zone).

At these high elevations in the cold north-facing Terrace Lake cirque, POC may trade dominance particularly with Tsuga mertensiana. T. mertensiana, like POC, prefers moist, cool ground, and above Terrace Lake this is provided by a valley bottom which channels runoff from snowpacks lingering into late July and not by permanent streams and seeps which is so often the habitat of POC in other parts of the basin. Hence, POC can be considered to run the entire range of major coniferous forest types in the Klamath Province, from the lowland coastal western hemlock and Sitka spruce-dominated forests, through Douglas fir and mixed conifer forest, up into the white fir, red fir, and even mountain hemlock-dominated forests. There is no other coniferous tree in this region that associates with more major forest types. However, only in the vicinity of the Cedar Basin candidate RNA is POC known to co-occur with the most typical dominant tree of the subalpine zone in the Pacific Northwest (T. mertensiana) and the most characteristic tree of the California Canadian Zone (A. magnifica).

Endemic and Unusual Klamath and Trinity Mountains Flora:

The flora of Cedar Basin shares the majority of its plants with other mountain regions of California. However, about 10% of its flora is either endemic to the Klamath Province or has a wider distribution (usually northwestern North American), but is known in California only from the Klamath region.

The most specific group of endemic plants include two taxa which so far as is known, only occur in Cedar Basin. Both of these taxa were discovered during the field work for this report.

Arctostaphylos klamathensis (Edwards, Keeler-Wolf, and Knight, 1983, tached) is a very distinctive species of manzanita known only from the

Terrace Lake basin. The species is a gray-green, low prostrate plant which locally dominates the shrub layer of the open red fir forest and mountain chaparral (see Fig.1 and Appendix 3). In general form it resembles the common and widespread pine-mat manzanita, A. nevadensis. However, inflorescence form, leaf color and glandular pubescence indicate it is probably more related to another low elevation Klamath endemic, A. knightii, and a widespread chaparral species, A. viscida. Its restricted occurrence here may have been the result of past hybridization during a different climate in the Pleistocene when its parent forms occupied the same region. The species is distinctive enough so it is unlikely to occur more widely in other mountains of the Klamath Province (where botanical collecting has been relatively thorough). It should be considered very rare and endangered (sensu Powell, 1974) by virtue of its extremely limited distribution and small population size.

The other taxon apparently restricted to Cedar Basin is a showy species of Penstemon, which as yet has been undescribed. Again, this plant is locally quite common on the rock outcrops and sunnier and drier cliffs above Terrace and Upper Cliff Lakes. The species shares the pubescent anthers and rock-hugging habit of two montane species known from the Klamath region, P. rupicola and P. davidsonii (neither of which occurs in the basin). The glacous,serrate leaves resemble the foliage of P. rupicola, but the blue (and not magenta) flowers more closely resemble P. davidsonii (Fig. 2). The uniformity of characteristics throughout the population in Cedar Basin and the absence of the species it most closely resembles suggest that it is indeed a separate genetic entity, and not a simple recent hybrid. Specific determination will have to wait until the summer of 1983 when more material can be collected. As with the manzanita, this species is probably rare enough by virtue of its limited range, to

FIGURE 1: The endemic Arctostaphylos klamathensis, dominant shrub of the open red fir forest SW of Terrace Lake

FIGURE 2: Penstemon sp. nov. a common plant of gabbro outcrops S. of Upper Cliff Lake.

be considered very rare and endangered.

In addition to the above two newly discovered species which most certainly deserve additional study and protection, two other species known only from the Northern Trinity Mountains and adjacent Scott Mountains occur in the basin. These are Lupinus croceus (on the CNPS rare list Powell, 1974) a yellow flowered herbaceous perennial lupine restricted to rather dry ultramafic soil, and Mimulus primuloides ssp. linearifolius, a yellow flowered bog and meadow inhabiting monkeyflower.

Several more widespread Klamath Province endemics also occur locally and are on the CNPS lists. These include Lilium washingtonianum var. purpurascens, Castilleja arachnoidea, Lewisia leana, and Chamaecyparis lawsoniana, itself. Other Klamath endemics and widespread species known in California only from the Klamaths are noted in Appendix 1.

Unusual Bog Species:

Several widespread species on the CNPS rare list also occur in the basin. All of the species inhabit moist areas such as rocky seeps and bogs. Two are attractive and conspicuous plants of the bog and lake community at Cedar and Lower Cliff Lake: Drosera rotundifolia and Menyanthes trifoliata (Fig. 3). Darlingtonia californica (Calif. pitcher plant) an unusual and rather scarce endemic to the serpentine bogs of Northern California and Coastal Oregon is also common, particularly at Cedar Lake.

Carex gigas, an inconspicuous sedge of the moist cirque wall seeps above Terrace Lake is considered to be a rare species both by Munz (1959) and Powell (1974).

Several other meadow and bog species at Cedar Lake are unusual; Narthecium californicum, Tofieldia glutinosa, and Schoenolirion album are all primitive members of the Lily family endemic to the California region.

FIGURE 3: Drosera rotundifolia, Carex sp., and Kalmia colonizing submerged log in Cedar Lake. Menyanthes in shallow water beyond.

FIGURE 4: Meadow fringe at Cedar Lake with Sisyrinchium idahoense and Pedicularis attolens.

Two other notable monocots are the attractive and uncommon Sisyrinchiums, S. Elmeri (mountain golden-eyed grass, fig. 4) and S. idahoense, a glaucous-leaved pale blue flowered species.

The uncommon and beautiful gentians Gentiana newberryi and G.amarella also inhabit the meadowy rim around Cedar Lake.

The High Diversity of Ericaceae:

The density and diversity of this family in the basin has been commented upon by several visitors (G. Keator, W. Rodrick, in lit.). Personally, I have never seen such a high diversity of genera in the Ericaceae in such a small area. Nine genera and 13 species of ericads are known from the area (see Appendix 1). Many of these seem to be faring well in the basin because of the required edaphic conditions. Leucothoe, Gaultheria, Kalmia, Ledum, Rhododendron and some Vaccinium species are restricted to moist more or less boggy areas and several other genera (Cassiope, Phyllodoce and certain Arctostaphylos, e.g. A. klamathensis) may be locally successful in part because of their tolerance of the harsh ultramafic soil. This may be particularly true of Cassiope and Phyllodoce, both of which are usually found at substantially higher elevations.

Zoological Justification:

A scaled photo survey of animal tracks was made by Ron Kelly in March and April 1980. Subsequent identification by Dr. W. Z. Lidicker of the Museum of Vertibrate Zoology, U.C. Berkeley and Dr. Marshall White Dept. of Forestry, U.C. Berkeley proved that a large diversity of carnivores inhabit the basin. Martens, bobcats, mountain lions, and black bears left footprints in the snow, as did most likely fishers and wolverines. The last two species are particularly rare in California. The wolverine is especially rare with

the only recent reports coming from the high Northern Sierra and the Klamath Mountains (Ingles 1965, and M. White in lit.).

In addition, two uncommon and sensitive species of birds, the spotted owl and pileated woodpecker regularly use the forested areas of the basin. Both species prefer old growth and overmature forests and certainly find suitable habitat in the cedar groves and the mixed conifer forests of the lower basin. Maintanence of the basin in its least disturbed state is the most important factor in insuring the continued residence of both the carnivores and birds.

PHYSICAL FEATURES

Geomorphology and Topography:

Cedar Basin lies at the head of the South Fork of the Sacramento River. The basin is oriented to the northeast and has had all of its major features shaped by glaciation in the Pleistocene. The basin was dominated by two glaciers in the last ice age; one which spilled down the slopes southeast of Cedar Lake and a larger one that flowed from hanging glaciers beneath the high ridges south of Cliff and Terrace lakes and converged with the Cedar Lake glacier below Lower Cliff Lake (Figs. 5&6).

Cedar Basin lies within an area of the Northern Trinity Mtns. known as "The Eddys." The origin of the name is unclear, but the swirling pattern of ridges and smoothed, glacial valleys seen in an aerial view does suggest the shapes of eddies in a river. The lateral moraine that formed between the Gumboot Lake glacier to the north and the Cedar Basin glacier forms the northwestern boundary of the RNA. The low lateral moraine separating the Cedar lake and Cliff Lake glaciers is crossed in the open mountain chaparral on the jeep road between the two lakes.

FIGURE 5: Upper Cliff, Cliff, and Lower Cliff lakes showing path of Cliff Lake glacier. Note the U-shaped valley of South Fork of Sacramento River beyond.

FIGURE 6: From Lower Cliff Lake looking SW to glacially carved cirque holding Upper Cliff Lake (in clouds).

The effect of glaciation can clearly be seen in the polished gabbro on the bench north of Upper Cliff Lake and 1/2 mile southwest of Cedar Lake. All the lakes in the basin owe their origins to glaciation. The steep cliff face behind Cliff Lake rises from the lake at ca. 5800ft. to 7149ft. in less than 1/2 mile. In contrast, the valley floor from Cedar Lake to the northwest boundary, a distance of nearly a mile only drops from ca. 5750 to 5420ft.

Geology:

As was mentioned, Cedar Basin lies within a huge area of ultramafic rocks and is entirely underlain by them. Gabbro, a"salt and pepper" colored rock with a consistency similar to granite is the dominant type throughout the basin. The boulders along the outlet to Lower Cliff Lake and the vertical cliffs behind Cliff and Terrace lakes are all made of gabbro. Within the gabbroic mass are small outcrops of other rocks. Boulders of a partly serpentinized crystalline talc are occasional as are dikes of andesite from one to four feet thick.

The only other rocks in the basin occur northwest of Cedar Lake and its outlet stream and are variously altered forms of peridotite (serpentinite). The northeastern boundary area consists of various sizes of rounded rocks and boulders deposited from the main ridge to the west in a lateral moraine rising up from the northwestern shore of Cedar Lake.

This ultramafic terrane is composed of old rocks (Ordovician to Carboniferous, Irwin, 1966) which erupted on or below the sea floor. These rocks changed in composition with the addition of sea water (to form serpentinite) or originated from magma from the basaltic mantle of the earth,which solidified slowly well under the surface (to form gabbro). Both of these rocks share many

chemical characteristics, reflecting their similar origins beneath the ocean floor off the shores of continents. Similar aged ultramafic rocks occur southeast in the western Sierra, and further northeast in the Blue and Wallowa mountains of Northeast Oregon. All of these mountains are thought to be related , and may have once formed a continuous mountain range on the western edge of North America (Alt and Hyndman 1975, 1978).

Gabbroic rocks produce few economically important minerals, and the small amount of serpentinite is unlikely to contain any more than small traces of nickel, chromium, asbestos, talc, cinnabar, and other economic deposits known from the Klamath ultramafic terrane. The mineral content of the basin's rocks provide little more of real value than a severe and interesting edaphic environment influencing the structure and composition of the local flora.

Climate:

Cedar Basin is under the same climatic regime as most of California, but receives slightly more precipitation in the summer and winter than many mountainous areas to the south (Sierra, North Coast Range, and Transverse Ranges). Precipitation averages between 70 and 80 inches annually (Kahrl, 1979), most of which falls as snow in the winter. Kahrl (1979) shows the average April 1 snow depth for the Cedar Basin area to be over 100 inches, as high as any area in the Klamath Province. Snow accumulates at high elevation forested sites to at least an average of 180 inches as on the northeast slopes of Terrace Lake basin, and commonly to 144 inches at other upper elevation forested sites (evidence from height of lichen growth on trees). In contrast, at the lower elevations on southeast facing slopes snow rarely averages deeper than 36 inches. The cold, shaded

upper slopes of the basin thus provide a distinctly different microclimate, conducive to the dominance of such trees as mountain hemlock, from the lower elevation, sunny , quickly drying slopes covered with open mixed conifer forest.

VEGETATION

Shallow Lakes and Ponds:

Eight permanent or semipermanent bodies of water exist in the basin. They range from relatively deep and rockbound Cliff Lake to small, shallow ponds only 30 feet across. With the exception of Cliff Lake, all lakes and ponds in the basin have an obvious zone of aquatic vegetation inhabiting the shallower water areas. The best developed open water communities occur at Cedar and Lower Cliff lakes (Fig. 7) because of their relatively constant water level, large size, and uniformly shallow depths. The following species are either submerged, emergent, or anchored floating-leaved hydrophytes characteristic of the basin:

Isoetes occidentalis
Isoetes bolanderi
Nuphar polysepalum
Menyanthes trifoliata
Potamogeton natans
Sparganium angustifolium
Scirpus validus
Heleocharis montividensis var. *parishii*
Dulichium arundinaceum
Carex rostrata

Bog and Meadow:

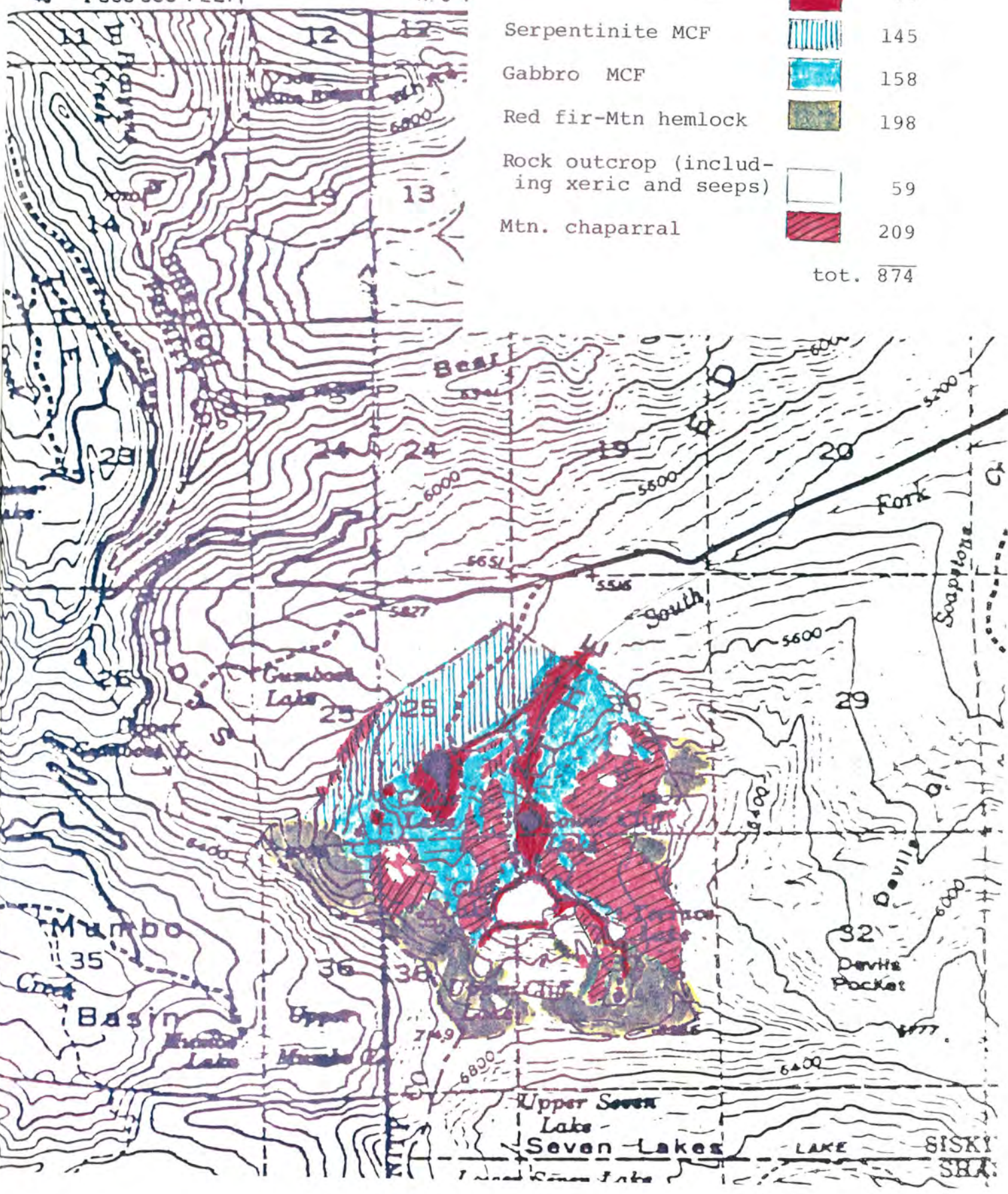
At Cedar Basin there are no extensive wet meadowy areas. Apart from narrow, discontinuous fringing areas with characteristic meadow vegetation bordering Cedar and Lower Cliff lakes and several unnamed ponds, the majority of the permanently moist non-forest habitat in the basin is best classified as bog.

The bog community around Cedar Lake, and to a lesser extent at

VEGETATION MAP

scale: 2in.=1mi.

	acreage
lake, bog, & meadow	40
Port Orford Cedar	65
Serpentinite MCF	145
Gabbro MCF	158
Red fir-Mtn hemlock	198
Rock outcrop (including xeric and seeps)	59
Mtn. chaparral	209
tot.	874



Lower Cliff Lake consists of both raised, hummocky areas topped largely with ericacious shrubs, and lower mucky areas dominated by members of the Cyperaceae and such species as Darlingtonia californica (Fig. 8). Both types are underlain by thick layers of partially decomposed vegetation that may feel shaky underfoot. However, the raised areas are better drained and support a nearly continuous shrub layer of Kalmia, Ledum, Vaccinium occidentale, and Spiraea douglasii. The hummocks form a natural barrier between the open lake community and the low bog and meadow vegetation (Fig.9). These hummocks may have originated from either floating logs lodging near the shore of the lake or emergent boulders and rocks.. On some younger floating logs and on the edges of hummocks grow thick clumps of Drosera, small individuals of Darlingtonia, Tolfieldia, Narthecium, and sedges such as Carex buxbaumii, and C. aquatalis. The uncommon, dimunitive Gaultheria humifusa also creeps over emergent rocks and logs in this zone, and small trees of POC are frequently interspersed among the shrubs.

The low, mucky bog is dominated by members of the sedge family including; Scirpus microcarpus, Heleocharis montevidensis, Carex ormantha, C. integra, and C. buxbaumii. Aster alpigenus ssp. andersonii grows in this zone as does Schoenolirion album. In slightly more elevated moist areas Darlingtonia becomes dominant and often forms dense stands further away from the lake associating with POC and Ledum (Fig. 10).

Where more soil has developed such as near the inlet streams to both Cedar and Lower Cliff lakes, herbaceous meadow vegetation predominates including:

Botrychium simplex
Sidalcea oregana ssp. spicata
Viola macloskeyi
Hypericum anagalloides
Polygonum bistortoides
Dodecatheon alpinum ssp. majus

Figure 7:Lower Cliff Lake w/ Nuphar, Potamogeton, and other aquatics in forground; fringe of POC and transitional mixed conifer-red fir forest in background.

Figure 8:Bog vegetatio around Cedar Lakeww/ low mucky type on left slightly raised type (w/ Darlingtonia), and hummock w/ POC and Kalmia in background.

Figure 9: Cedar Lake w/ hummock border, lak vegetation (in distance), mucky bog, and meadow fringe(in forground).

Gentiana newberryi	Sisyrinchium idahoense
Gentiana amarella	S. elmeri
Mimulus primuloides	Juncus nevadensis
Pedicularis attolens	J. orthophyllus
Parnassia palustris var. californica	Carex hoodi
Potentilla gracilis ssp. nuttallii	C. laeviculmis
Lotus pinnatus	C. raynoldsii
Epilobium lactiflorum	Deschampsia caespitosa
Perideridia oregana	Agrostis idahoensis
Helenium hoopesii	Gliceria striata
Aster occidentalis	G. elata
Tritelia hyacinthina	Calamagrostis canadensis

The bog community at Lower Cliff Lake is not as well developed as at Cedar Lake. Fringing vegetation at Lower Cliff includes Leucothoe, Ledum, Spiraea douglasii, and Rosa pisocarpa. However, Kalmia is rare and Vaccinium occidentale is apparently absent. Only at the lake's southern end are there fairly large patches of Drosera and Darlingtonia. Other lakes and ponds in the basin do not support fringing bog vegetation largely because of a more widely fluctuating water table.

Port Orford Cedar Forest:

In Cedar Basin this forest type (most similar to SAF type 231) is clearly an edaphic climax community reliant upon permanent moisture. Port Orford cedar groves fringe Cedar, Terrace, Cliff, and Lower Cliff lakes and follow their outlet streams all the way down the banks of the South Fork of the Sacramento River. Groves also occur above these lakes and streams at seeps, along intermittent rivulets, and streams up to nearly 6400ft. The highest elevation

FIGURE 10: Edge of bottomland POC forest with understory of bog species; Darlingtonia californica, Ledum glandulosum predominating.

FIGURE 11: Bottomland POC forest South of Lower Cliff Lake showing the many fallen trees typical of this forest type.

cedar is an individual ca. 30 ft. tall growing between the two tarns in the upper Terrace Lake basin at ca. 6350 ft.

Because POC tends to thrive in these moist situations throughout the basin, the mountain alder and willow-dominated high mountain riparian community typical in similar situations throughout much of California does not occur here. POC is quite shade tolerant (much more so than the light-loving alders and willows) and tends to exclude all other trees and large shrubs from the riparian habitat available in the basin.

There are two redily discernable types of POC forest at Cedar Basin. One occurs along rocky streams and lakesides, where the surrounding drainage is good and the moisture is restricted to within a few feet of surface water. The other is in rather flat bottomland as around the western and southern shores of Cedar Lake, near the inlet to Lower Cliff Lake, and near the confluence of the Cedar and Lower Cliff Lake outlet streams. Both types are strongly dominated by POC (see Tables 1,2,&3 and Appendix 3), but the understory vegetation and the forest structure differs.

The bottomland POC forest has the highest density stands of any forest in the basin with often between 40 & 50 trees over 6 ft. in height in $100m^2$ (1600-2100/acre see Table 1). The trees are often very shallowly rooted, and because of the saturated muddy, sandy, or peaty soil often are uprooted. Passing through such groves means climbing over and under many fallen trunks (Fig.11). Many recently fallen trees (apparently resulting from heavy 1981 snowfall) have pools of water filling their newly formed basal craters, attesting to the high water table. Sample plots 1,2, and 3 were in this type of forest around Cedar Lake. This type often lies immediately back from the bog and meadow surrounding the lakes.

TABLE 1

Tree density of Chamaecyparis lawsoniana in five 10x10m plots.

Plot #	Mt. Al.	POC	L.P.	D.F.	I.C.	W.F.	WWP	J.P.	M.H.	R.F.
1		33		1	1	2	1	1		
2		43	3	1		4	1		1	
3	3	15	4			4	2			1
4		10	1			1	1			1
5		21	1				2		4	3

TABLE 2

Sapling and seedling density of C. lawsoniana on 10x10m plots.

Plot #	Mt.Al.	POC	L.P.	D.F.	I.C.	W.F.	WWP	J.P.	M.H.	R.F.
1		18								
2	1	22							1	
3	2	13	6			32	5			9
4		5								15
5		5							1	

TABLE 3

Basal area (sq. inches) of C. lawsoniana trees on 10x10m plots.

Plot #	Mt.Al.	POC	L.P.	D.F.	I.C.	W.F.	WWP	J.P.	M.H.	R.F.	Total
1		751		10	5	53	314	24			1157
2		1053	343	13		25	29		1		1464
3	1	921	139			18	1			10	1090
4		3419	79			1	1			1	3501
5		1594	227				542		301	338	3002

Because drainage is slow and the soil saturated just below the surface, many of the more shade tolerant bog and meadow species are shared, including Ledum, Gaultheria, Leucothoe, and Darlingtonia. However, there is a core of species which is more or less restricted to the understory of this bottomland forest and they include:

Botrychium multifidum ssp. silaifolium
Athyrium filix-femina
Caltha howellii
Viola glabella
V. adunca
Pyrola secunda
Prunella vulgaris ssp. lanceolata
Mitella pentandra
Physocarpus capitatus
Alnus tenuifolia
Cornus stolonifera
Linnaea borealis ssp.longifolia
Lilium kelleyanum
Allium validum
Habenaria sparsiflora
Listera convallarioides

Much of the bottomland forest around Cedar Lake appears to have suffered fire damage perhaps 100 years ago. Many bare snags, charred at the base, still stand (Fig.12) and no living trees larger than ca. 22 inches dbh can be found. The largest living POC measured in the bottomland type forest was 48" just north of Lower Cliff Lake.

The growth rates of POC appear to be the most rapid of any conifer in the basin. This certainly has much to do with the continual water supply afforded to most individuals. Table 4 compares the ages of breast height saplings of various species sampled in the vicinity of Cedar Lake. The age of a 28 inch diameter POC stump near the outlet of Lower Cliff Lake was 260 years. Ron Kelly reports a stump measuring 42 inches in diameter and an age of ca. 400 years near the northeast boundary. The largest individual POC measures ca. 52 inches dbh and is probably 450-500 years old. This individual grows along the outlet stream of Lower Cliff Lake in the well-drained stream and lakeside type of POC forest.

FIGURE 12: View S toward peak 7149 from serpentinite mixed conifer forest on moraine NW of Cedar Lake. Charred snags of POC along W side of Cedar Lake in middle ground.

TABLE 4

Ages of breast height saplings sampled near Cedar Lake.

Species	#1	#2	#3
C. lawsoniana	32	35	24
P. contorta	35	57	52
P. jeffreyi	34	37	
A. concolor	66	51	
A. magnifica	48	62	
T. mertensiana	56	67	
P. menziesii	36	38	

Sample plots 4 and 5 are representative of the streamside-rocky lakeshore type of POC forest. The densities of trees are notably less, yet basal area is greater than on the sampled bottomland plots (Table 3). This is perhaps because fewer trees can get established along the narrow, often steep sided, and variable watercourses. Nevertheless, the few that can are able to sink their roots down to a permanent moisture supply and perhaps grow with less competition for light and space than the bottomland individuals. The streamside and rocky lakeside POC forest, although rarely extending more than 5m from the water's edge, (Fig. 13) has by far the highest basal area of any forest type sampled in the basin (see Table 5), up to 350 $in.^2/100m^2$ (the equivalent of 984 $ft.^2$/acre). The understory species in this subtype are typical of other moist forest types found in the basin and include; Leucothoe davisae, Goodyera oblongifolia, Chimaphila umbellata, Pyrola picta, Vaccinium arbuscula, Pteridium aquilinum, and Pedicularis semibarbata.

Mixed Conifer Forest:

Two types of mixed conifer forest (SAF type 243 with variations) also occur in the basin. One is restricted to the serpentinite moraine on the northwest side of the area, and the other occurs on gabbro at the lower elevations in the basin.

The serpentine type is an open forest with dominance being traded between several species including; Pseudotsuga menziesii, Abies concolor, Pinus jeffreyi, and P. lambertiana. Calocedrus decurrens and Pinus monticola also commonly occur in this forest type, and Pinus ponderosa and P. contorta murrayana occur locally. The understory is dominated by typical mountain chaparral shrubs including; Quercus vaccinifolia, Arctostaphylos nevadensis, A. patula,

TABLE 5

Comparative statistics for the three sampled forest types.

	Plot #	av. plot elev. (feet)	Basal Area (ft^2/acre)	height[1] (ft.)	Trees/acre	Snow Depth[2] (feet)
P. O. Cedar	1	5700	326	53	1619	5
	2	5700	411	56	2146	6
	3	5710	306	55	1174	6.5
	4	5680	984	83	567	6
	5	6240	844	77	1255	10.5
serpentine MCF	6	5500	160	59	393	2.5
	7	5660	303	103	279	3.5
	8	5760	247	92	73	3
	9	5900	195	91	105	4.5
	10	6050	104	75	223	4.5
red fir-mt.hem.	11	6320	383	82	968	12
	12	6375	148	67	243	5.5
	13	6800	367	79	725	15.5
	14	6560	277	104	227	6.5
	15	6400	351	83	336	10.5

[1] estimated from rangefinder measurements of three tallest trees

[2] estimated from average distance from ground to edge of lichen growth on three randomly chosen trees

Ceanothus prostratus, and Amalanchier pallida. Two other shrubs, Rhamnus californicus ssp. occidentalis and Ribes roezlii appear to be locally restricted to this forest type.

Five 50x20m (0.1ha) plots were sampled in this subtype. The results are presented in Tables 6, 7, and 8. The general exposure of the entire serpentinite subtype is southeast. This, coupled with the nutrient-poor, well drained substrate causes the forest to often be very open. Compared with the other two sampled types of forest in the basin, this forest averages both the lowest density of trees and the smallest basal area (see Table 5). Some indication of shifting dominance resulting from differing microclimatic conditions is indicated by a stronger tendency for P. jeffreyi to dominate the driest, most southerly-facing slopes and A. concolor, and increasingly P. monticola to dominate at higher elevations (above 6000ft.). P. menziesii is also somewhat more common at lower elevations on this subtype and may occasionly reach surprisingly large proportions (two trees approaching 60" dbh were measured and are the largest of any species seen in the basin). Conspicuous by its absence from this type is Abies magnifica (even at higher elevations), although this species is a common component of the gabbro mixed conifer subtype.

The gabbro subtype differs from the previous forest by its higher abundance of A. magnifica and P. contorta murrayana. All other tree species noted on serpentinite also occur, though P. jeffreyi and C. decurrens are of much lower importance. No vegetation sampling was done in this subtype, but both the substrate (often with a higher water table) and the overall northerly exposure of the lower elevations of the basin appear to influence the different composition of this subtype. The MCF forest on gabbro is also rather open, but not so much as the serpentinite type. Understory shrubs are also mostly typical mountain chaparral species, but Chrysolepis

TABLE 6

Tree density on 50x20m Mixed Conifer Forest plots.

Plot #	W.F.	D.F.	S.P.	J.P.	WWP	L.P.	I.C.
6	33	27	17	2	1	5	11
7	35	4	5	6			19
8	3	6	1	2	2		4
9	16	4	3		2		1
10	29	2	13	2	6		3

TABLE 7

Sapling and seedling density on 50x20m Mixed Conifer Forest plots.

plot #	W.F.	D.F.	S.P.	J.P.	WWP	L.P.	I.C.
6	31	5	12	7		3	10
7	91		2	1			
8	7	5	1				
9	1				2		
10	27	2	2	1	5		2

TABLE 8

Basal area ($in.^2$) on Mixed Conifer Forest plots.

plot #	W.F.	D.F.	S.P.	J.P.	WWP	L.P.	I.C.	total
6	1032	2356	987	9	95	40	1158	5677
7	2114	3960	511	3065			1134	10784
8	1147	4575	177	800	296		1787	8782
9	4566	1448	505		332		71	6921
10	2161	205	1137	17	161		3	3685

sempervirens, a species often characteristic of open red fir forest, appears largely restricted to this type. This forest shows a gradual clinal shift with increased elevation toward the composition of red fir-mountain hemlock forest. Its affinity to this type can be recognized even at lower elevations by occasional trees of Tsuga mertensiana and understory shrubs such as Leucothoe davisiae and Vaccinium arbuscula in more mesic areas.

Herbs and subshrubs are rather widely scattered in both subtypes of MCF. A few such as Lupinus croceus, Eriophyllum lanatum var. lanceolatum, Convolvulus malacophyllus, Lotus crassifolius, Angelica californica, Galium boreale, Cirsium andersonii, and Iris purdyi appear locally restricted to the serpentinite subtype. Others such as:

Xerophyllum tenax
Berberis nervosa
Linum perenne ssp. lewisii
Viola purpurea
Silene lemmonii
Polygonum douglasii
P. spergulairaeforme
Frasera albicaulis
Ipomopsis aggregata
Agoseris sp.
Phacelia sp.
Cynoglossum occidentale
Pedicularis semibarbata
P. racemosa
Monardella odoratissima ssp pallida
Gayophytum nuttallii
Solidago californica
Senecio aronicoides
Eupatorium occidentale
Habenaria unalascensis
& Elymus glaucus

are centered in the MCF zone in the basin, occurring more commonly on the gabbro subtype. Lists of all herbs and shrubs occurring on each of the 15 sample plots can be found in Appendix 3.

Red Fir-Mountain Hemlock Forest:

This forest (most similar to SAF type 207) is the dominant type on all northerly exposures at higher elevations in the basin. Five 50x20m (0.1ha) vegetation plots were chosen in this forest type and the results presented in Tables 9, 10, and 11 and Appendix 3. There is a large degree of variation in dominance and cover in this type. This ranges from dense, closed stands dominated by red fir (e.g. plot 13 and Fig. 14) on northeast and northwest facing slopes, to cold, mesic valley bottom stands dominated (or co-dominated)by T. mertensiana and occasionally P. contorta murrayana (plots 11 & 15, Fig. 15), to open, rather scenescent red fir forest (plot 14), and very open forest co-dominated by A. magnifica, P.monticola, and P. contorta (plot 12, and Fig.1).

The understory is dominated in open forests with shallow soil by shrubs of the mountain chaparral including Quercus vaccinifolia, Arctostaphylos klamathensis , A. nevadensis, A. patula, and Ceanothus prostratus. The endemic A. klamathensis is locally a very important member of this type, covering more than 60% of the ground in some areas. In the more closed canopy, shady stands the understory is sparse with pyrolaceous and saprophytic species such as Pyrola picta, Chimaphila umbellata, and Corallorhiza maculata predominating. In mesic stands Leucothoe, Vaccinium arbuscula, V. scoparium, Anemone quinquefolia var. minor and Pyrola secunda are often common.

Even on the most mesic sites within this forest tree size and basal area coverage are not as high as in many parts of the Sierra Nevada red fir forest. The greatest basal area sampled in Cedar Basin (plot 11, 383 ft.^{2}/acre) is less than ½ as great as red fir forest sampled at the Mt. Pleasant candidate RNA (Keeler-Wolf and Keeler-Wolf, 1981) or the Onion Creek candidate RNA (Talley, 1977),

FIGURE 13: Typical narrow riparian stand of POC along outlet stream from Terrace Lake. Red fir dominates only a few meters away to the right.

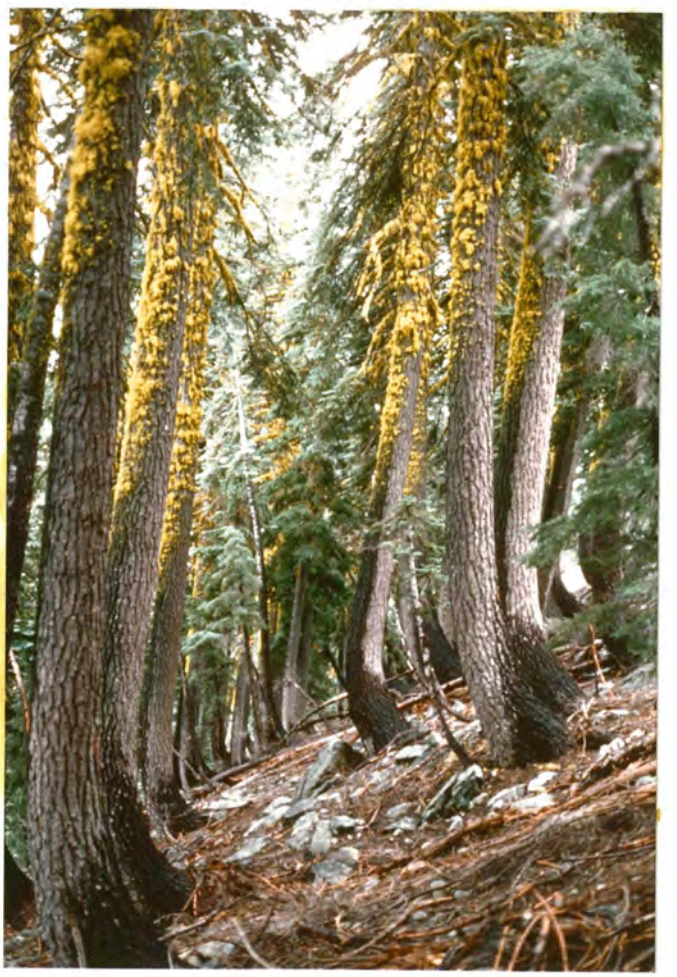


FIGURE 14: Closed red fir-mountain hemlock forest on NE facing slope above Terrace Lake. Note sparse understory and lichen growth indicating average winter snow depth of ca. 180 ".

TABLE 9

Tree density on 50x20m red fir-mountain hemlock plots.

plot #	W.F.	R.F.	M.H.	L.P.	WWP	POC
11	8	48	118	29	10	26
12		21		25	14	
13		124	49		6	
14		38	9		9	
15		45	35		3	

TABLE 10

Sapling and seedling density on 50x20m red fir-mountain hemlock plots.

plot #	W.F.	R.F.	M.H.	L.P.	WWP	POC
11	2	26	99	1		24
12		59		11	22	
13		27	25		1	
14		217	9	1	14	
15		41	10	2		

TABLE 11

Basal area (sq. in.) on 50x20m red fir-mountain hemlock plots.

plot #	W.F	R.F.	M.H.	L.P.	WWP	POC	total
11	664	3812	4125	4288	149	566	13604
12		2393		1991	873		5257
13		11308	1590		156		13053
14		8066	538		1246		9851
15		6843	5062		586		12492

in typical Sierra red fir forest. The difference in stature is also substantial. Many red firs at Mt. Pleasant reach 175ft. in height and the average canopy height is ca. 138ft. Average canopy height in the analagous forest at Cedar Basin is only 83ft. and the tallest fir measured, only 120ft. DBH of Cedar Basin red fir is similarly reduced with the largest measured being 45.5" as opposed to many at Mt. Pleasant over 60". These differences in density and stature can probably best be attributed to the soil type. Gabbro underlies the local forest and is a chemically deficient and harsher substrate than the granite underlying the Mt. Pleasant area. Tolerance of ultramafic soils by A. magnifica has not been tested to my knowledge. However, it is probable that like Pseudotsuga (Zobel and Hawk, 1980), it exhibits reduced vigor on ultramafic soils. The abundance of Tsuga mertensiana at such relatively low elevations (locally dominant to ca. 6050ft.), on the other hand, may result from the potential for this species to tolerate the poor soil more effectively than A. magnifica.

The relatively open nature of this and the mixed conifer forests in Cedar Basin is clearly not the result of an overmature and scenescent tree crop. Regeneration of all tree species is relatively good as indicated by a typically uneven age class distribution (see Appendix 3).

Mountain Chaparral:

This shrub dominated community covers large areas of shallow, rocky soil in the basin. It is especially noticeable in the eastern portion where it extends across almost the entire west-facing slope. The area dominated by this vegetation may actually be substantially larger than the listed figure because of the many small unmappable pockets within the openings of mixed conifer and red fir-mountain

hemlock forest. Three species; Quercus vaccinifolia, Arctostaphylous nevadensis, and A. patula are the most widespread and important plants of the basin's mountain chaparral. Q. vaccinifolia is particularly abundant, dominating in most areas. Other widespread, important shrubs are the low mat-like Ceanothus prostratus, Amalanchier pallida, and Holodiscus boursieri, the latter particularly abundant on stablized talus along the ridge east of Terrace and Lower Cliff lakes. Prunus emarginata, Ceanothus velutinus, and Chrysolepis sempervirens are less common and more local shrubs of this community. The endemic Arctostaphylos klamathensis is a local dominant of this community west and southwest of Terrace Lake.

Many herbs in this community are also shared with the more open, xeric rock outcrop community. Some of the most common and characteristic species include:

Cheilanthes gracillima
Onychium densum
Streptanthus tortuosus
Arabis rectissima
Arabis platysperma
Arenaria nuttallii ssp. gregaria
A. congesta
Calyptridium umbellatum
Eriogonum umbellatum var. umbellatum
Apocynum pumilum
Phlox diffusa
Nama lobbii
Mimulus layneae
Penstemon deustus
P. azureus
P. newberryi ssp. berryi
Castilleja arachnoidea
Sedum obtusatum ssp. boreale
Lomatium macrocarpum
Kellogia galioides
Haplopappus greenei
Chrysothamnus nauseosus albicaulis
Antennaria rosea
Stephanomeria lactucina
Juncus parryi
Calamagrostis koelerioides

The local mountain chaparral appears to be largely an edaphic climax. Unlike many areas in California, past fire history does not

affect its presence or distribution as much as the shallow, rocky soil and slope exposure. Large isolated trees without fire scars on the west-facing slope above Terrace Lake (Fig. 16) and in other areas attest to the permanence and relatively fire-free history of the surrounding mountain chaparral. The widespread local presence of this community may reflect the tolerance many of its constituents have of extremely well drained, rocky ultramafic soil.

Rock Outcrop:

On the steep rock faces south of Cliff Lake and at the head of the Terrace Lake cirque, several species of rock-loving plants occur in a unique community. The rock outcrop environment varies greatly from xeric, exposed gabbro slabs to shaded seeps nestled within deep crevices (Figs. 17 & 18). The flora of these outcrops can thus conveniently be divided into xeric and mesic components.

Many of the dry-adapted species are shared with the mountain chaparral and are previously listed. However, a few species appear restricted to actual extensive rock outcrops. Notable among these is the local endemic penstemon, which is actually one of the most common plants in its limited habitat. Other characteristic species include Lewisia leana, Sitanion hystrix, and Stipa columbiana.

The mesic phase of the rock outcrop community shares some species with the bogs and meadows, but the moist-to-wet, yet rocky (and usually shady) environment produces a unique situation. Several herbs and shrubs appear locally restricted to this habitat:

Cryptogramma acrostichoides
Adiantum pedatum var. aleuticum
Polystichum lonchitis
P. lemmonii
Cystopteris fragilis
Athyrium alpestre
Delphinium depauperatum
Actaea rubra ssp. arguta
Polygonum davisae
Phyllodoce empetriformis

FIGURE 15: South shore of Terrace Lake with dense forest dominated by mountain hemlock, lodgepole pine, and red fir. Port Orford cedar and western white pine are also common.

FIGURE 16: Mountain chaparral east of Terrace Lake showing large isolated Jeffrey pine and White fir.

FIGURE 17: Typical xeric rock outcrop at head of Upper Cliff Lake cirque. Red fir-mountain hemlock forest to the left. Mt. Shasta in distance.

FIGURE 18: Romanzoffia sitchensis, a rare species of shaded rock crevices, known in California only from the Klamath Province.

Cassiope mertensiana

Nemophila parviflora var. austinae

Romanzoffia sitchensis

Boykinia major

Saxifraga ferruginea

S. bryophora

Heuchera pringlei

Ribes nevadense

Spiraea densiflora

Luetkea pectinata

Sibbaldia procumbens

Sorbus scopulina

Epilobium angustifolium

Rhamnus purshiana

Acer glabrum var. torreyi

Arnica diversifolia

Antennaria alpina var. media

Disporum hookeri

Carex gigas

Carex spectabilis

BOUNDARIES

In general, the original boundaries delimited in the Oct. 1980 RNA proposal are acceptable. The topographic borders on the northwest, the south, and the east are in keeping with the maintenance of the natural integrity of the basin. The owners of the ca. 120 acres of private land within the basin have a strong desire to maintain their land, in particular the area adjacent to the proposed RNA, in a natural state (Ron Kelly pers. com.). Consequently, no buffer area would seem necessary. The artificial northeastern boundary across the basin floor coincides with the edge of the proposed Devil's Zoo timber sale, and represents the only modification from the original proposal. Originally, a more arcuate northeast boundary was drawn (before the extent of the timber sale was determined). The present straight-line boundary was drawn with the intention of including as much as possible of the bottomland POC forest and adjacent mixed conifer forest near the edge of the timber sale.

IMPACTS

The major potential and real impacts on the Cedar Basin candidate RNA include camping, logging, and woodcutting pressure, continued vehicle use of road 39N05Y, and the threat of cedar root rot infesting the local POC groves.

The existing road into the basin has been in existence for many years (perhaps 50 or more). As evidenced by its poor condition it is not much used except by high-clearance four-wheel drive-type vehicles. The impact of visitors at Cedar Lake, the most accessible attraction in the basin, has been surprisingly light over the years. Although four long-established campsites exist at the lake, all are on the eastern side away from the immediate shore with its sensitive boggy hummocks and meadow fringe. The western edges of the lake, which house the most extensive and diverse bog and meadow vegetation, are very lightly effected, without even a noticeable footpath. This light use is probably a result of the shallowness of the lake, making it unlikely to support a large and attractive (to fishermen) trout population. Similarly, the single large campsite at Lower Cliff Lake is away from the shore on the north side. Lightly used paths lead along the western and eastern edge of Lower Cliff Lake, but the dense fringing stands of cedar and the saturated boggy areas on the eastern and southern sides have not been noticeably disturbed. The long-established campsite along the eastern side of Cliff Lake is at the edge of the rather unsensitive mountain chaparral formation. The fringe of POC has not been strongly effected, and because no bog or meadow vegetation surrounds the lake, impacts on existing lakeshore vegetation are minimal. All campsites visited in 1982 were relatively free of litter. No well established campsites

exist at any other parts of the basin.

The past effects of logging and woodcutting are most noticeable along the road to Cedar Lake. Selective logging occurred many years ago in the serpentinite MCF northwest of Cedar Lake and on other parts of the lower basin. Stumps at least 50 years old are widely scattered (3-5/0.1ha). Skid trails and other residual effects are not generally noticeable. One logging spur is still apparent on the northwest side of Cedar Lake, though overgrown with saplings.

Woodcutting use has increased in recent years in the lower parts of the basin. Downed and dead standing trees of POC and other species have been taken, particularly along the road to Cedar Lake and around the lake, itself. Apparently, some live trees have been cut as well. At present, the lower basin has been posted as a no woodcutting area. However, chainsaws were heard on Forest Service land within the basin in mid-September.

The timber value of the accessible forested parts of the basin is relatively low, except for the POC stands. The open, somewhat stunted nature of both the mixed conifer and red fir-mountain hemlock forests suggests again that their value is higher for research than for marketable saw logs.

Although the poor condition of the road insures, to some degree its light use, there is some evidence of more recent increased impact. A few areas show the effects of detouring with subsequent erosion and destruction of soil and surrounding vegetation. This is particularly apparent about ¼ mile northeast of Cedar Lake.

Without question the most threatening impact on the basin is the potential spread of cedar root rot. Needless to say, the value of the basin as an RNA would be seriously diminished if the local cedars were infected with this disease.

RECOMMENDATIONS

In my opinion, the most parsimonious way to deal with all of the above impacts is to gate the Cedar Basin road near to where it branches from road 40N37. Access by motor vehicles could thus be restricted, but not precluded. This is necessary because the Kellys and particularly the Dobsons require road access to their private cabins at Cliff Lake. Also vehicle access could be given to researchers or other parties interested in the natural features of the proposed RNA.

Management problems with gates include vandalism and the logistics of distributing keys or combinations to the proper personnel. A gate might most prudently be placed at a spot where cross-country access around the gate is difficult. Perhaps the most likely site is along the Cedar Basin road about 200 yards from the main road where downhill slopes on the moraine are steeper, and a cut-bank borders the inside of the road. The initial expense and maintenance of the gate requires careful consideration.

Being an owner of private land in the mountains, I am well aware of the forms of vandalism and destruction taken upon similar locked gates. Everything is used; from ramming with trucks, to bolt cutters, portable cutting torches, and dynamite. Thus, precautions such as concealed, guarded padlocks, heavy gage steel posts and bars, and a substantial concrete foundation for the posts should be taken when putting up the gate. Keys or combinations could be distributed to the private land owners and could be held at the Mt. Shasta Ranger Station for other interested parties arranging in advance to use the area. Perhaps maintenance costs could be defrayed by a small entrance fee (similar to a campground fee) charged to all users.

LITERATURE CITED

Alt, D. and D. Hyndman. 1975. Roadside Geology of Northern California. Mountain Press.

Alt, D. and D. Hyndman. 1978. Roadside Geology of Oregon. Mountain Press.

Bailey, L.H. 1978. The Cultivated Conifers in North America. Allenheld Osmun/Universe Books.

Davis, G.A. 1966. Metamorphic and granitic history of the Klamath mountains. In E. Bailey (ed.) Geology of Northern California. Calif. Division of Mines Bull. 190.

Diller, J.S. 1902. Topographic development of the Klamath Mountains. U.S. Geol. Survey Bull. 196.

Edwards, S., T. Keeler-Wolf, W. Knight. 1983. Arctostaphylos klamathensis, a new species of manzanita from Siskiyou County, California. The Four Seasons 4 (6):

Franklin, J.F. and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. U.S. Forest Service Gen. Tech. Rep. PNW-8.

Griffin, J.R. and W.B. Critchfield. 1972. The distribution of forest trees in California. U.S. For. Serv. Res. Pap. PSW-82.

Ingles, L. 1965. Mammals of the Pacific States. Stanford.

Irwin, W.P. 1966. Geology of the Klamath Mountains Province. In E. Bailey (ed.) Geology of Northern California. Calif. Div. Mines Bull. 190.

Kahrl, W. (ed.) 1979. The California Water Atlas. State of California.

Keeler-Wolf, T. and V. Keeler-Wolf. 1981. An ecological survey of the proposed Mt. Pleasant Research Natural Area, Plumas National Forest, California. Unpublished report on file at PSW, Berkeley.

Kliejunas, J. and D. Adams. 1980. An evaluation of Phytopthora root rot of Port Orford cedar in California. U.S. For. Serv. pest management report 80-1.

Munz, P. A. 1959. A California Flora. U. C. Press.

Powell, R. 1974. Inventory of rare and endangered vascular plants of California. Special Publication 1, Calif. Native Plant Soc.

Raven, P. H. and D. A. Alelrod. 1978. Origin and relationships of the California Flora. U. C. Pub. Bot. 72.

Talley, S. 1977. An ecological survey of the Onion Creek candidate research natural area on the Tahoe National Forest. Unpublished report on file at PSW Berkeley.

Zobel, D. B. and G. M. Hawk. 1980. The environment of Chamaecyparis lawsoniana. Am. Midl. Nat.103:280-297.

APPENDIX 1

VASCULAR PLANT LIST

This list includes all species identified during my visits in August and September. Several additional species noted by other observers are also listed. Nomenclature for the most part is from Munz 1968. A California Flora and Supplement.

The following symbols refer to habitat types:

l=lake

b&m=bog and meadow

POC=Port Orford cedar forest

MCF=mixed conifer forest

rf-mh=red fir-mountain hemlock forest

mc=mountain chaparral

ro=rock outcrop (xeric)

s&s=spring and seep (mesic rock outcrop)

The symbol "KO" refers to plants known in California only from the Klamath Province.

FERNS AND ALLIES:

Botrychium multifidum ssp. silaifolium POC
B. simplex b&m
Pteridium aqualinum var. pubescens POC, MCF
Cheilanthes gracillima mc, ro
Cryptogramma acrostichoides s&s, ro
Onychium densum ro
Adiantum pedatum var. aleuticum s&s
Polystichum lonchitis s&s, ro
P. lemmonii s&s, ro, KO
Cystopteris fragilis s&s
Athyrium filix-femina POC
A. alpestre s&s

CONIFERS

Abies concolor MCF, rf-mh
A. magnifica var. shastensis rf-mh, MCF
A. nobilis MCF, rf-mh (individuals with some,but not all of the species characters)

Abies lasiocarpa(reported by Keator) ? KO
Pinus lambertiana MCF
P. monticola MCF, rf-mh
P. contorta var. murrayana POC. MCF, rf-mh
P. ponderosa MCF
P. jeffreyi MCF
Picea breweriana (reported by Mary Taylor) ? KO
Tsuga mertensiana POC, MCF, rf-mh
Pseudotsuga menziesii MCF
Calocedrus decurrens MCF
Chamaecyparis lawsoniana POC KO

FLOWERING PLANTS

Ranunculaceae
Caltha howellii POC, b&m
Actaea rubra ssp. arguta s&s
Delphinium depauperatum s&s
Anemone quinquefolia var. minor POC, MCF, rf-mh
Aquilegia formosa s&s

Berberidaceae
Berberis nervosa MCF

Nymphaceae
Nuphar polysepalum l

Malvaceae
Sidalcea oregana ssp. spicata b&m

Sarraceniaceae
Darlingtonia californica b&m, POC

Droseraceae
Drosera rotundifolia b&m

Linaceae
Linum perenne ssp. lewisii MCF

Violaceae
Viola glabella POC
V. purpurea MCF
V. cuneata (Keator) MCF
V. macloskeyi b&m
V. adunca b&m

Hypericaceae
Hypericum anagalloides b&m

Cruciferae
Streptanthus tortuosus mc
Thalaspi glaucum (Keator) MCF
Arabis rectissima mc
A. platysperma mc, ro
A. holboellii var. retrofracta MCF, mc

Caryophyllaceae
Stellaria sp. ? MCF

Arenaria nuttallii ssp. gregaria mc, ro
A. congesta mc, MCF, ro
Silene lemmonii MCF

Portulacaceae
Lewisia leana ro, mc, KO
Calyptridium umbellatum mc

Polygonaceae
Eriogonum umbellatum var. umbellatum ro, mc
Rumex angiocarpus b&m
Polygonum bistortoides b&m
P. douglasii MCF
P. spergulariaeforme MCF
P. davisiae s&s, ro

Primulaceae
Dodecatheon alpinum ssp. majus b&m

Ericaceae
Ledum glandulosum var. californicum b&m, POC
Rhododendron occidentale POC, MCF
Kalmia polifolia var. microphylla b&m
Phyllodoce empetriformis s&s, ro, KO
Cassiope mertensiana s&s, ro
Leucothoe davisiae POC, b&m, rf-mh
Gaultheria humifusa b&m
Arctostaphylos nevadensis MCF, rf-mh, mc
A. patula mc, MCF, rf-mh
A. mc, rf-mh
Vaccinium occidentale b&m
V. arbuscula POC, MCF, rf-mh
V. scoparium rf-mh KO

Pyrolaceae
Pyrola picta MCF, rf-mh
Pyrola picta ssp. integra MCF, rf-mh
P. secunda POC, rf-mh
Chimaphila umbellata MCF, rf-mh
Pterospora andromedea MCF, rf-mh

Gentianaceae
Gentiana newberryi b&m
G. amarella b&m
Menyanthes trifoliata l
Frasera albicaulis MCF

Apocynaceae
Apocynum pumilum MCF, mc

Convulvulaceae
Convulvulus malacophyllus MCF

Polemoniaceae
Polemonium californicum rf-mh
Phlox diffusa mc
Microsteris gracilis MCF
Ipomopsis aggregata MCF

Linanthus ciliatus MCF

Hydrophyllaceae
Nemophylla parviflora var. austinae s&s
Phacelia sp. (Keator) ?
Nama lobbii mc, ro
Romanzoffia sitchensis s&s KO

Boraginaceae
Cynoglossum occidentale MCF

Scrophulariaceae
Mimulus primuloides ssp. linearifolius b&m KO
M. layneae mc
M. guttatus b&m, s&s
Penstemon deustus mc, ro
P. azureus mc, MCF
P. parvulus mc
P. laetus (Keator) ?
P. newberryi ssp. berryi mc
P. sp. nov.. ro KO
Collinsia torreyi MCF, rf-mh
Pedicularis semibarbata MCF, POC
P. attolens b&m
P. racemosa MCF
Castilleja arachnoidea mc KO
C. miniata s&s

Labiatae
Scutellaria antirrhinoides MCF
Prunella vulgaris ssp. lanceolata POC b&m
Monardella odoratissima ssp. pallida MCF

Crassulaceae
Sedum obtusatum ssp. boreale ro, mc, KO

Saxifragaceae
Parnassia palustris var. californica b&m
Boykinia major s&s, POC
Saxifraga bryophora s&s
S. ferruginea s&s
Mitella pentandra POC
Heuchera merriami (Keator) ?
Heuchera pringlei s&s, ro KO
Ribes divaricatum var. klamathense POC KO
Ribes nevadense s&s
Ribes roezlii MCF

Rosaceae
Physocarpus capitatus POC
Spiraea douglasii b&m, POC
S. densiflora s&s
Luetkea pectinata s&s KO
Holodiscus boursieri mc
Ivesia sp. (Keator) ?
Potentilla glandulosa ssp. nevadensis MCF, b&m
P. gracilis ssp. nuttallii b&m
Fragaria platypetala POC

Sibbaldia procumbens s&s
Rubus leucodermis rf-mh
R. parviflorus POC
Rosa pisocarpa var. rivalis POC, MCF, b&m
Prunus emarginata mc
Sorbus scopulina s&s
Amelanchier pallida MCF, rf-mh, POC, mc

Leguminosae
Lupinus albicaulis MCF
L. adsurgens ? MCF
L. croceus MCF KO
Trifolium longipes b&m, s&s
T. sp. ? b&m
Lotus crassifolius MCF
L. pinnatus b&m
L. oblangifolius b&m

Betulaceae
Alnus tenuifolia b&m, POC

Fagaceae
Chrysolepis sempervirens MCF, mc
Quercus vaccinifolia MCF, rf-mh, mc

Salicaceae
Salix scouleriana POC, MCF

Onagraceae
Epilobium angustifolium s&s
E. lactiflorum s&s, b&m
Gayophytum nuttallii MCF
G. humile MCF

Rhamnaceae
Rhamnus purshiana s&s
R. californica ssp. occidentalis MCF
Ceanothus velutinus mc
Ceanothus prostratus mc, MCF, rf-mh

Loranthaceae
Arceuthobium campylopodum MCF

Aceraceae
Acer glabrum var. torreyi s&s

Umbelliferae
Sanicula nevadensis MCF
Perideridia oregana b&m, s&s
Ligusticum californicum s&s, POC
Lomatium macrocarpum mc
Angelica californica MCF

Cornaceae
Cornus stolonifera POC

Rubiaceae
Galium boreale MCF KO

Kellogia galioides MCF, mc, rf-mh

Caprifoliaceae
Linnaea borealis ssp. longiflora POC
Symphoricarpos acutus POC, MCF
Lonicera conjugialis POC

Compositae
Madia minima MCF
Helenium hoopesii b&m
Eriophyllum lanatum var. lanceolatum MCF
Haplopappus greenei mc, ro
Solidago californica MCF
Chrysothamnus nauseosus ssp. albicaulis MCF, mc
Aster brickellioides var. glabratus MCF, ro, rf-mh, mc, KO
A. occidentalis b&m
A. alpigenus ssp. andersonii b&m
Erigeron inornatus MCF, rf-mh
Achillea lanulosa MCF, b&m
Arnica discoidea var. elata MCF
A. diversifolia s&s
Senecio triangularis POC, b&m, s&s
S. aronicoides MCF
Antennaria alpina var. media s&s, ro
A. rosea mc, ro
Eupatorium occidentale MCF
Cirsium andersonii MCF
Microseris nutans b&m
Agoseris sp. MCF
Stephanomeria lactucina mc, ro
Hieracium albiflorum MCF rf-mh
H. cynoglossoides MCF, rf-mh
H. bolanderi

Potamogetonaceae
Potamogeton natans l

Liliaceae
Xerophyllum tenax MCF
Narthecium californicum b&m
Tofieldia glutinosa ssp. occidentalis b&m
Schoenolirion album b&m, POC
Disporum hookeri s&s
Zigadenus veneosus s&s, b&m
Veratrum californicum POC, s&s, b&m
Lilium washingtonianum var. purpurescens MCF KO
L. kelleyanum POC, s&s

Sparganiaceae
Sparganium angustifolium l

Amaryllidaceae
Allium validum POC
Tritelia hyacinthina b&m

Iridaceae
Iris purdyi MCF
Sisyrinchium idahoense b&m

Sisyrinchium elmeri b&m

Orchidaceae
Habenaria unalascensis MCF
H. dilatata var. leucostachys b&m
H. sparsiflora s&s, POC
Listera convallarioides POC
Goodyera oblangifolia POC, MCF, rf-mh
Corallorhiza maculata rf-mh

Juncaceae
Juncus parryi mc, ro, MCF
J. nevadensis b&m
J. balticus b&m
J. orthophyllus b&m
Luzula divaricata rf-mh, mc

Cyperaceae
Scirpus microcarpus b&m
S. validus l
Heleocharis montividensis var. parishii l, b&m
Dulichium arundinaceum l
Carex rostrata l, b&m
C. hoodi b&m, s&s
C. gigas s&s
C. spectabilis s&s
C. integra b&m
C. raynoldsii b&m
C. buxbaumii b&m, s&s
C. ormantha b&m
C. laeviculmis b&m, s&s
C. aquatalis b&m
C. leporinella b&m

Graminae
Sitanion hystrix ro
Deschampsia caespitosa b&m
Poa canbyi ro
Stipa columbiana ro
Muhlenbergia filiformis ro, s&s
Calamagrostis koelerioides ro, mc
C. breweri b&m
C. canadensis b&m, POC
Danthonia intermedia MCF, ro
Agrostis exarata b&m, MCF
A. idahoensis b&m
Glyceria striata b&m
G. elata b&m, POC
Elymus glaucus MCF

APPENDIX 2

VERTEBRATES KNOWN OR SUSPECTED FROM CEDAR BASIN

FISH

Brook Trout (Salvelinus fontinalis);in Cliff, Lower Cliff, Upper Cliff, and Terrace lakes

AMPHIBIANS

Pacific Giant Salamander (Dicamptodon ensatus); known from headwaters of Sacramento River

Rough-skinned newt (Taricha granulosa); seen in most lakes

Ensatina (Ensatina eschscholtzi oregonensis); possibly occurs

Black salamander (Aneides flavipunctatus); possibly occurs

Western toad (Bufo boreas); seen around Cedar Lake

Pacific treefrog (Hyla regilla) common around lakes & streams

Red-legged frog (Rana aurora); seen in Cedar, Lower Cliff lakes

REPTILES

Sagebrush lizard (Sceloporus graciosus); seen in mtn. chaparral

Western skink (Eumeces skiltonianus); possibly occurs

Northern alligator lizard (Gerrhonotus coeruleus shastensis); possibly occurs

Rubber boa (Charina bottae); possibly occurs

Ringneck snake (Diadolphus punctatus); possibly occurs

Sharp-tailed snake (Contia tenuis); possibly occurs

Common garter snake (Thamnophis sirtalis fitchi); possibly occurs

Mountain garter snake (Thamnophis elegans);possibly occurs

Oregon garter snake (Thamnophis couchi hydrophila); possible

Racer (Coluber constrictor); possibly occurs

Gopher snake (Pituophis melanoleucus); possibly occurs

California mountain kingsnake (Lampropeltis zonata); possible

Western rattlesnake (Crotalus viridus oreganus); possible

BIRDS

This list includes only those species observed or heard in the study area during my visits in mid-August and mid-September 1982.

Great blue heron; seen and heard at Cedar and Cliff lakes Aug.&Sept.

Pintail; a flock of nine was seen on Sept. 16 at Cedar Lake.

Goshawk; one seen NW of Cedar Lake Sept 15

Sharp-shinned hawk; one seen being mobbed by Stellar's jays at Cedar Lake Aug. 15

Cooper's hawk; an immature seen in several parts of the basin, Sept.

Red-tailed hawk; seen both visits

Mountain quail; seen in mtn. chaparral in Aug.

Spotted sandpiper; Terrace Lake, Aug.

Spotted owl; heard from mixed conifer forest NW of Cedar Lake on evening of Sept. 17

Rufous hummingbird (?) probably this species seen near Cedar Lake in Aug.

Belted Kingfisher; commonly seen at all, but Upper Cliff lake, Sept.

Red-shafted (Common) flicker; seen both visits

Pileated woodpecker; heard on Sept. 16, borings common in lower basin

Red-breasted sapsucker; seen W of Cliff Lake Aug 15

Hairy woodpecker; seen in lower basin in Sept.

White-headed woodpecker; seen Aug. and Sept.

Hammonds (?) flycatcher; seen in lower basin in Sept.

Dusky flycatcher; seen commonly in August

Western wood pewee; seen in August

Olive-sided flycatcher; seen and heard in Aug.

Violet-green swallow; seen flying over ridges in Aug.

Stellar's jay; common both visits

Common raven; seen over ridges in Aug.

Clark's nutcracker; upper elevations both visits

Mountain chickadee; common both visits

Red-breasted nuthatch; common both visits

Brown creeper; seen both visits

Dipper; Sacramento River near NE boundary Aug.

House wren; Mtn. chaparral Aug.

Rock wren; above Upper Cliff Lake Aug.

American robin; seen both visits

Hermit thrush; migrants seen in Sept., probably breeds here,too

Mountain bluebird; summit of highest peak Aug.

Townsend's solitare; fairly common, upper elevations both visits

Golden-crowned kinglet; lower basin Aug. and Sept.

Ruby-crowned kinglet; seen Sept.

Solitary vireo; heard Aug. and Sept.

Warbling vireo; heard Aug.

Orange-crowned warbler; seen Aug. and Sept.

Nashville warbler; seen near Cedar Lake Aug.

Yellow-rumped (Audubon's) warbler; Aug. and Sept.

Hermit warbler; seen Aug.

MacGillivray's warbler; seen in mtn. chaparral Aug.

Wilson's warbler; near Cedar Lake Aug.

Brown-headed cowbird; seen near Cedar Lake Aug.

Western tanager; seen in Aug.

Black-headed grosbeak; seen in Aug.

Evening grosbeak; flock seen in Sept. near Terrace Lake

Cassin's finch; seen both visits

Pine siskin; seen both visits

Red crossbill; heard in Sept.

Green-tailed towhee; mtn. chaparral both visits

Savannah sparrow; seen near Lower Cliff Lake Sept.

Dark-eyed (Oregon) junco; common both visits

Chipping sparrow; seen in Aug.

White-crowned sparrow; migrants seen in Sept.

Fox sparrow; seen both visits

MAMMALS

Dusky shrew (Sorex obscurus); possible

Vagrant shrew (S. vagrans); possible

Water Shrew (S. palustris); possible

Trowbridge shrew (S. trowbridgei); possible

Broad-handed mole (Scapanus latimanus); possible

Little brown myotis (Myotis lucifugus); possible

Fringed myotis (M. thysanoides); possible

California myotis (M. californicus); possible

Long-eared myotis (M. evotis); possible

Silvery bat (Lasionycteris noctivagus); possible

Hoary bat (Lasiurus cinereus); possible

Big brown bat (Eptescius fuscus); possible

Black-tailed hare (Lepus californicus); possible

Snowshoe hare (L. americanus); possible

Mountain beaver (Aplodontia rufa); possible

Beechey ground squirrel (Otospermophilus beecheyi) possible

Golden-mantled ground squirrel (Callospermophilus lateralis); common

Yellow pine chipmunk (Eutamias amoenus); possible

Townsend's chipmunk (E. townsendii); common

Douglas Squirrel (Chickeree) (Tamiasciurus douglasii); very common

Northern flying squirrel (Glaucomys sabrinus); possible

Mazama pocket gopher (Thomomys mazama); common

Deer mouse (Peromyscus maniculatus); the most common mammal of the basin . live-trapping on Sept 17 &18 yielded 77% capture rate for this species.

Bushy-tailed wood rat(Neotoma cinerea); possible

Western red-backed mouse (Clethrionomys occidentalis); possible

Long-tailed meadow mouse (Microtus longicaudus); possible

Oregon meadow mouse (M. oregoni); possible

Montane meadow mouse (M. montanus); possible

Western jumping mouse (Zapus princeps); possible

Porcupine (Erethizon dorsatum); possible

Red fox (Vulpes fulva); possible

Coyote (Canis latrans); choruses heard both visits

Black bear (Ursus americanus); fresh scats and tracks seen both visit

Raccoon (Procyon lotor); possible

Marten (Martes americana); tracks identified in 1980

Fisher (M. pennanti); tracks identified in 1980

Long-tailed weasel (Mustella frenata); possible

Ermine (M. erminea); possible

Wolverine (Gulo luscus); tracks identified in 1980

Mountain lion (Felis concolor); tracks seen in Aug. near Cedar L.

Bobcat (Lynx rufus); tracks identified in 1980

Mule deer (Odocoileus hemionus); fairly common, seen both visits

APPENDIX 3

VEGETATION PLOT DESCRIPTIONS*

PLOT 1: Dense, closed POC grove on W. side of Cedar L. Slopes gradual, 2-5° to the NE. Typical bottomland, dark organic soil, sparse understory.

DBH (inches)	#WWP	#D.F.	#I.C.	#POC	#W.F.	#J.P.
1				3		
1.5				2		
2				2	1	
2.5			1	1		
3				6		
3.5		1		1		
4				2		
4.5				3		
5				1		
5.5				3		1
6				1		
7				1		
8				3	1	
8.5				1		
10				2		
20	1					
totals	1	1	1	33	2	1 = 39 grand total

herbs and shrubs present: Athyrium filix-femina, Anenome quinquefolia var. minor, Goodyera oblongifolia, Pyrola secunda, Amalanchier pallida.

*NOTE: plots 1 through 5 are 10x10m, plots 6 through 15 are 50x20m.

PLOT 2: Dense, closed POC forest W side of Cedar L. more open on S. side of plot adjacent to stream. Slopes 2-5°, mesic herbaceous understory in sunny opening.

DBH (inches)	POC	W.F.	L.P.	WWP	D.F.	M.H.
.5	5					1
1		1				
1.5	3	1				
2	9	1				
2.5	3					
3	1					
4	2				1	
4.5	1					
5	2	1				
5.5	2					
6	3			1		
7	2					
7.5	2					
8.5	1					
9	2					
10	1					
10.5	3		1			
11	1					
12			1			
13.5			1			
totals	43	4	3	1	1	1 = 52

herbs and shrubs present: Senecio triangularis, Carex sp., Viola glabella, Pteridium aquilinum, Anemone quinquefolia var. minor, Boykinia major, Lilium kelleyanum, Listera convallarioides, Pyrola secunda, Prunella vulgaris, Amalanchier pallida, Alnus tenuifolia, Rosa pisocarpa.

PLOT 3: More open POC bottomland forest. Slopes 0-5°, soil dark with afew gabbro boulders. Shrubby understory dominated by Ledum glandulosum. SW side of Cedar Lake.

DBH (inches)	POC	W.F.	R.F.	L.P.	M.Ald.	WWP
.5	2				3	
1	2	2		2		1
2						
2.5	1			1		
3	2	1				
3.5		1	1			
5.5	1					
6	1					
9	1					
11	1					
13				1		
14	1					
26	1					
TOTALS	15	4	1	4	3	1 = 28

shrubs and herbs present: Ledum glandulosum, Leocothoe davisiae, Vaccinium arbuscula, Linnaea borealis, Gaultheria humifusa, Amalanchier pallida, Lilium kelleyanum, Rosa pisocarpa, Pteridium aquilinum, Goodyera oblongifolia.

PLOT 4: Riparian POC forest 100m N of outlet to Lower Cliff Lake. General exposure NE, stream bank slopes 15-30° ; soil is rocky with decomposed gabbro and some boulders, free draining. Rhododendron occidentale dominant understory shrub.

DBH (inches)	POC	W.F.	R.F.	L.P.	WWP
.5		1			
1			1		1
1.5	2				
2.5	2				
7	1				
10				1	
21.5	1				
26	1				
30	1				
32	1				
35	1				
TOTALS	10	1	1	1	1

herbs and shrubs present: Rhododendron occidentale, Ledum glandulosum, Vaccinium arbuscula, Leocothoe davisiae, Schoenolirion album, Pedicularis semibarbata, Pyrola picta.

PLOT 5: Riparian POC forest along seepy area at S end of Terrace Lake. Slopes 10-15° exposure NNW. Understory shaded, sparse, mostly duff overlying rocks and boulders of gabbro.

DBH (inches)	POC	R.F.	M.H.	WWP	L.P.
2.5	1				
4	1				
4.5	1		2		
5	1	1			
5.5	2				
6			1		
7	3				
8	2				
9		1			
9.5				1	
10.5	1				
11	1				
11.5	1				
12	3				
13	1				
14	1				
14.5	1				
16	1				
17					1
17.5			1		
18	1	1			
24.5				1	
TOTALS	21	3	4	2	1 = 31

Shrubs and herbs present: Leucothoe davisiae, Goodyera oblongifolia, Chimaphila umbellata, Pyrola picta, P. secunda.

PLOT 6: Open serpentinite mixed conifer forest ca. 100m NW of edge of S. Fork Sacramento R. near confluence of outlet streams. SE exposure 0-10° slopes. Serpentinite boulders at upper end and Gabbro at lower end of plot. Mtn. chaparral shrubs covering ca.30% of plot.

DBH (inches)	W.F.	D.F.	S.P.	I.C.	L.P.	J.P.	WWP
.5	1	1					
1	3	2	2	1	2		
1.5	2	2	3	2		1	
2	6	1	4		1		
2.5	4	2	1				
3	6	5	2			1	
3.5	2	2		1			
4			1				
4.5	1	1			1		
5	2	2	1	1	1		
5.5		1		1			
6	1		1	1			
6.5		4					
7	1						
8.5	1						
9.5		1		1			
11							1
13			1				
14	1						
15		1					
16				1			
16.5	1						
17				1			
18.5		1					
22	1						
27				1			
31			1				
44		1					
TOTALS	33	27	17	11	5	2	1 = 96

herbs and shrubs present: Quercus vaccinifolia, Rhamnus californica ssp. occidentalis, Amalanchier pallida, Monardella odoratissima ssp. pallida, Eriophyllum lanatum var. lanceolatum, Angelica californica, Ceanothus prostratus, Pteridium aquilinum, Chimaphila umbellatum, Pyrola picta, Arenaria congesta, Convulvulus malacophyllus, Achillea lanulosa, Viola sp. Potentilla glandulosa, Apocynum pumilum, Pedicularis semibarbata, Hieracium cynoglossoides.

PLOT 7: Open serpentinite mixed conifer forest near NE corner of RNA ca 20m above road. Slopes 10-20° facing ESE; soil thin, rocky serpentinite, xeric understory with Q. vaccinifolia, C. prostratu predominating some duff under large douglas firs.

DBH (inches)	W.F.	I.C.	S.P.	J.P.	D.F.
.5	1				
1	2		1		
1.5	7	1			
2	4				
2.5	1				
3	4				
3.5	6	1			1
4	1	3	1		
4.5	2		1		
5	1	2			
6	2	2			
6.5		1			
7		2			
7.5		1			
8		1			
8.5		1			
11		1			
11.5	1	1			
12		1			
12.5					1
16.5	1				
17			1	1	
18			1		
18.5	1			1	
23		1		1	
28.5				1	
29				1	
33				1	
40.5	1				
43					1
55					1
TOTALS	35	19	5	6	4 = 69

herbs and shrubs present: Sanicula nevadensis, Pyrola picta, Kellogia gailoides, Pedicularis semibarbata, Cynoglossum occidentale, Chimaphila umbellata, Anemone quinquefolia var. minor, Hieracium cynoglossoides, Arctostaphylos nevadensis, A. patula, Quercus vaccinifolia, Ceanothus prostratus, Rhamnus californica ssp. occidentalis, Symphoriocarpos acutus, Cirsium andersonii.

PLOT 8: Mixed conifer forest on Serpentinite, ca. 200m NW of NW shore of Cedar L. SE facing slope 25-30° glacial till, boulders and large rocks, thin veneer of soil. light logging (3 stumps), very open forest w/ few young trees . Understory dominated by Q. vaccinifolia, but moister area on SW with Rhododendron and Rosa.

DBH (inches)	D.F.	W.F.	S.P.	I.C.	J.P.	WWP
8.5				1		
11						1
11.5				1		
15			1			
16						1
17					1	
17.5		1				
23	1	1				
25		1				
26				1		
26.5	1					
27	1				1	
33	1					
37	1			1		
37.5	1					
TOTALS	6	3	1	4	2	2 = 18

Herbs and shrubs: Juncus parryi, Lotus crassicaulis, Vaccinium arbuscula, Pteridium aquilinum, Lupinus croceus, Lupinus sp. Rosa pisocarpa, Pyrola pic, Quercus vaccinifolia, Arctostaphylos nevadensis, A. patula, Ribes roezlii, Ceanothus prostratus, Rhamnus californica, Rhododendron occidentale, Chimaphila umbellata.

PLOT 9: Serpentinite mixed conifer forest ca. 300m NW of Cedar Lake Slopes 25-30°, ENE exposure, open forest and understory, substrate-glacial till, Q. vaccinifolia dominant shrub.

DBH (inches)	W.F.	S.P.	D.F.	WWP	I.C.
.5			1		
1.5		1		1	
2	1				
4		1			
5			1		
9.5					1
14.5	1				
16	1				
16.5	1				
17.5	2				
18	1				
19	3				
19.5	1				
20	1				
20.5				1	
21	1				
23	1				
25	1	1			
26	1				
27			1		
33			1		
TOTALS	16	3	4	2	1 = 26

shrubs and herbs present: Q. vaccinifolia, Arctostaphylos nevadensis, A. patula, Ceanothusprostratus, Rhamnus californica occidentalis, Pyrola picta, Juncus parryi, Xerophyllum tenax, Goodyera oblongifolia.

PLOT 10 : Serpentinite mixed conifer forest, open forest ca 50m from the top of ridge NW of Cedar Lake. Slope 20-30° substrate serpentinite glacial till. Herbs and shrubs same as for plot #9.

DBH (inches)	W.F.	S.P.	J.P.	WWP	D.F.	I.C.
.5		2		1		
1	3	1	1			2
1.5	2			1		1
2	5					
2.5	3			1		
3	1					
3.5	1					
4	2	1				
4.5	1		1			
5	1					
6		1		1	1	
7	1	4		1		
9	1					
9.5	1					
10		1				
10.5				1		
12		1				
13		1				
15					1	
15.5	2					
17	1					
17.5	1					
18	1					
22	1					
22.5	1					
28		1				
TOTALS	29	13	2	6	2	3 = 52

PLOT 11: Lodgepole pine-mountain hemlock-red fir forest on valley bottom ca. 300m S of Terrace Lake. Slopes 15-20° to NNE on lower part where mtn. hemlock dominant, level near upper part where lodgepole pine dominant. Soil organic A horizon with scattered gabbro slabs and boulders, POC along intermittent runoff rill.

DBH (inches)	M.H.	R.F.	POC.	L.P.	WWP	W.F.
.5	6	2	4			
1	10	1	2			
1.5	8	1				
2	6	2	2			1
2.5	5	3	1			1
3	11	2	1		1	
3.5	3	1	3			
4	9	1	2			
4.5	1	4				
5	5	8				
5.5	5	1	1			
6	8	1	5		1	
6.5	3					
7	3	4			1	1
7.5	3		1			
8	5		1	1	1	
8.5	1					
9	6		1	2		1
9.5	3	1				1
10	2			1		
10.5	2	1	1	2	1	
11	2	1		2		
11.5	1			3		
12	4	2		2	1	1
12.5	1					
13	1			1		
13.5	2		1			1
14	1					
14.5		1		3	1	
15.5				3		
16		3		1		
16.5		2		1		
17				3		1
18				2		
18.5		1				
19		1				
20		3			2	
21.5					1	
TOTALS	118	48	26	29	10	8 = 239

herbs and shrubs: Leucothoe davisiae, Arctostaphylos nevadensis, Vaccinium arbuscula, V. scoparium, Amalanchier pallida, Q. vaccinifolia, Chimaphila umbellata, Anemone quinquefolia, Pyrola secunda, Aster brickellioides.

PLOT 12: Red fir-lodgepole pine-western white pine forest, 400m SW of Terrace Lake. open forest with scattered gabbro rocks and boulders. Slope 5-20° faces ENE. Understory dominated by Arctostaphylos klamathensis (type locality of species).

DBH (inches)	R.F.	WWP	L.P.
.5		1	
1	1	1	
1.5	1		1
2.5	1	3	1
3	1		2
3.5	1		1
4	1	3	
5	1	1	1
5.5		1	
6	1	1	2
7			1
8	1		5
9	1	1	
9.5	1		
10			3
10.5	2		1
11	1		3
11.5	1		1
12.5	1		1
13		1	
14	1		
16			1
20	1		
23	3		
26.5		1	
28.5			1
TOTALS	21	14	25 = 60

herbs and shrubs present: A. klamathensis (63% cover), A. nevadensis (6% cover), Quercus vaccinifolia (9% cover), A. patula (3% cover), Ceanothus prostratus (3% cover), Aster brickellioides, Arabis platysperma, Juncus parryi, Luzula divaricata, Sedum obtusatum ssp boreale.

PLOT 13: Red fir-mountain hemlock forest ca0.75km SW Terrace Lake at ca. 6800ft.. Closed forest except lower end, slopes steep 30-45°, NE facing. Snow lodging evident on many young trees ; understory mostly duff except lower plot w/ some open, rocky (gabbro) areas.

DBH (inches)	R.F.	M.H.	WWP
.5	1	1	1
1	3		
1.5	1	2	
2	3	1	1
2.5	5		
3	10	2	1
3.5	1	2	
4	5	4	1
4.5	2	2	
5	4	4	
5.5	2	4	
6	12	7	1
6.5	4	4	
7	6	6	
7.5	3	1	
8	6	1	
8.5	1	1	
9	3	4	
9.5	4		
10	2		
10.5	1	1	
11	2		
11.5	2	1	1
12	4		
13	3	1	
14	7		
14.5	5		
15	2		
15.5	3		
16	5		
16.5	2		
17	3		
18	1		
19	1		
20	1		
20.5	1		
40	1		
TOTALS	124	49	6 = 179

herbs ans shrubs present: Arctostaphylos klamathensis, Chimaphila umbellata, Juncus parryi, Sedum obtusatum ssp. boreale.

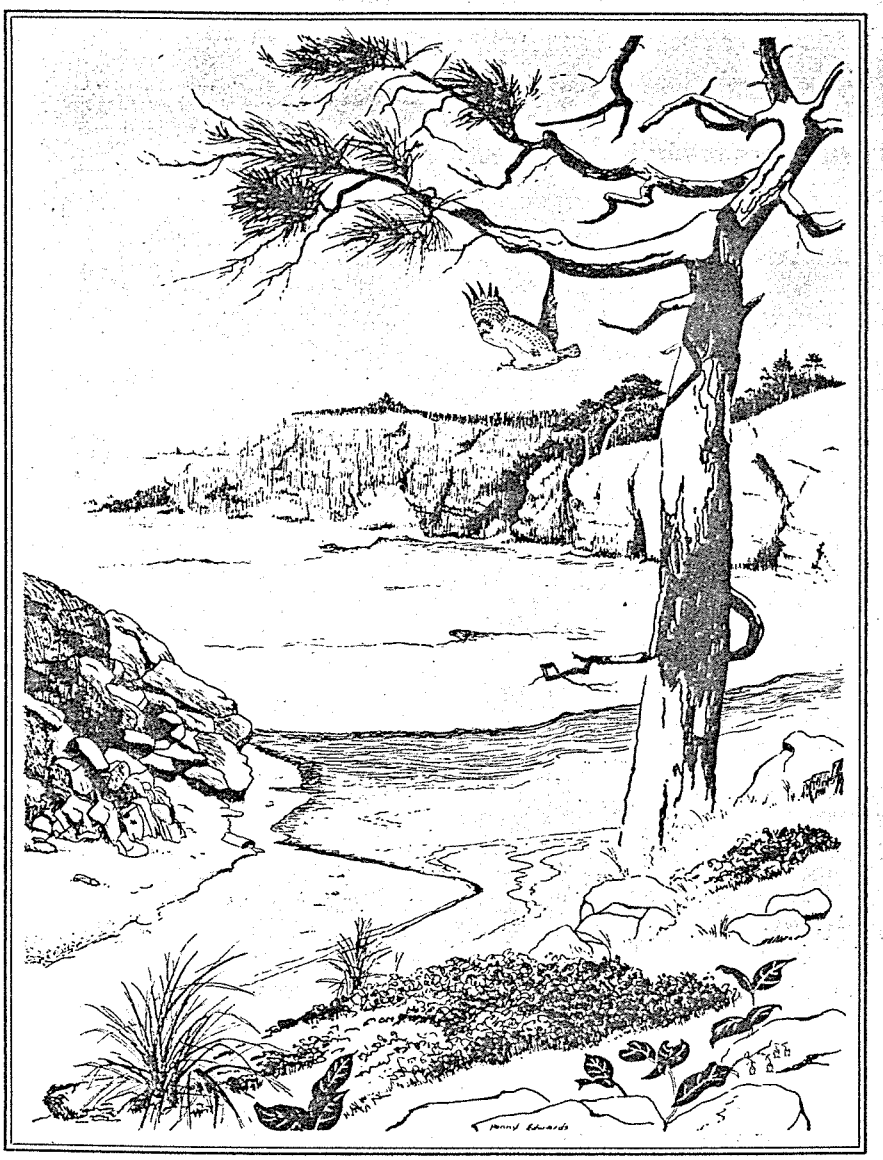
PLOT 14: Red fir-western white pine forest, open senescent , several large snags, much young fir regeneration, ca. 0.75km S of Terrace lake. Slopes 15-20° on bench w/ some exposed gabbro outcrops at top of plot, facing ENE. open understory w/ shrubs at top.

DBH (inches)	R.F.	M.H.	WWP
.5	1		
1	6	1	1
1.5	1	3	1
2		2	1
2.5	3		2
4	2		1
4.5	3		
5	3		
5.5	1		
6	2		
8	1		
10		1	
13		1	1
19	1		
20		1	
21	1		
23			1
27.5	1		
29	1		1
29.5	1		
30	1		
31	1		
33	1		
39.5	1		
45.5	1		
TOTALS	38	9	9 = 56

Herbs and shrubs: Juncus parryi, Chimaphila umbellata, Pyrola picta, Arctostaphylos klamathensis, Quercus vaccinifolia, A. nevadensis.

THE FOUR SEASONS

VOLUME 6, NUMBER 4 MARCH 15, 1983



Featuring new manzanita discoveries.

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A NEW ARCTOSTAPHYLOS (ERICACEAE) FROM SISKIYOU COUNTY, CALIFORNIA: PART I

by Stephen W. Edwards,
Todd Keeler-Wolf, and
Walter Knight

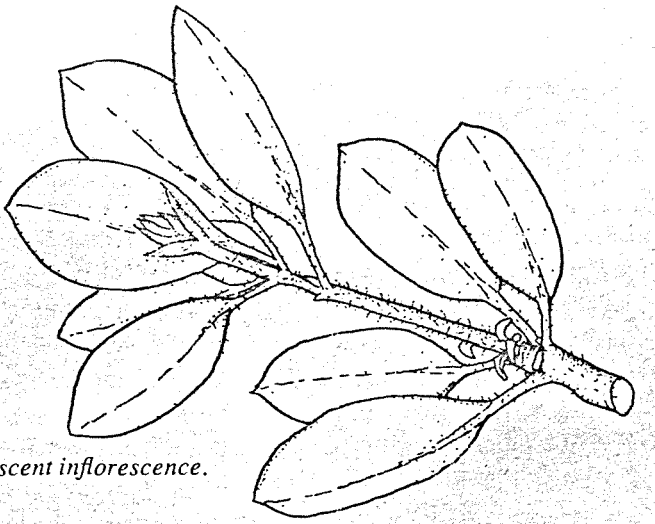
ABSTRACT: **Arctostaphylos klamathensis** Edwards, Keeler-Wolf, & Knight is described from Siskiyou County, California. It is compared with *A. nevadensis* Gray, *A. viscida* Parry, and *A. knightii* Gankin & Hildreth.

ON SEPTEMBER 19, 1982, TODD KEELER-WOLF encountered an unusual manzanita at Terrace Lake, near Cedar Lake, in Siskiyou County. On October 5, 1982, Stephen W. Edwards and Gregory Whipple, both of the Regional Parks Botanic Garden, visited the site in order to ascertain its extent more exactly and to study the relationship of the shrub to the other manzanitas of the locality.

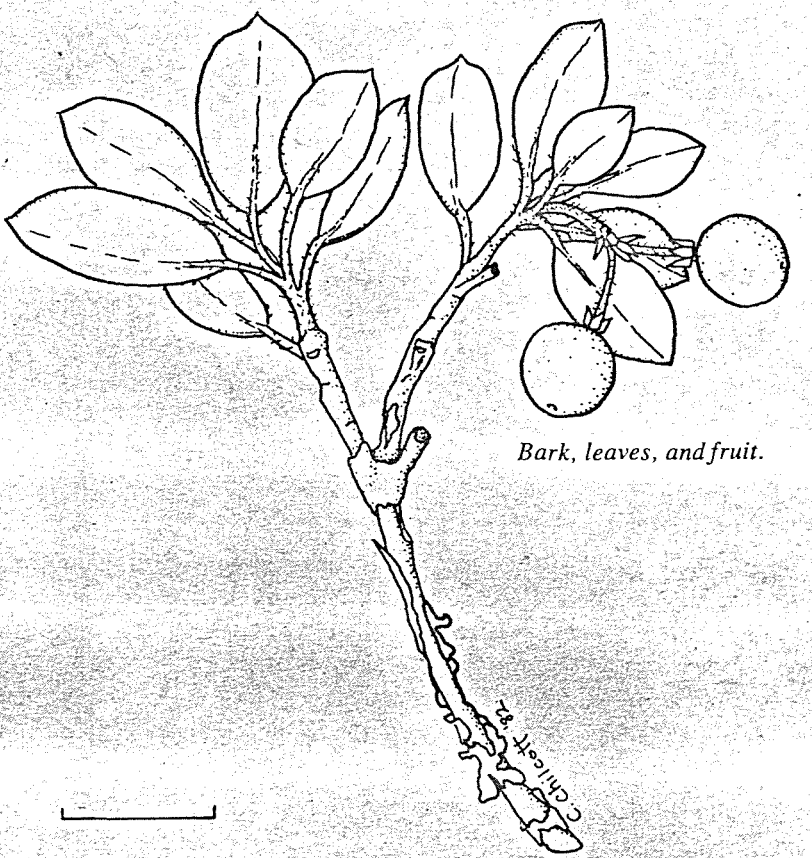
It was first seen by both parties at about 1884 m elevation on the trail between Cliff Lake and Terrace Lake. The plant is common near the outflow and along the southeastern edge of Terrace Lake (the type and so far the only known locality) at 1898 m and becomes very abundant, forming large colonies, at 1936 m southwest of the lake. It continues above this level to at least 2104 m on the rocky slopes southwest of the lake.

ASSOCIATED SPECIES

This manzanita occurs most commonly in mountain chaparral and open mixed forests of *Abies magnifica* var. *shastensis* Shasta Fir, *Pinus contorta* ssp. *murrayana* Lodgepole Pine, *P. monticola* Western White Pine, and *Tsuga mertensiana* Mountain Hemlock on shallow, rocky soil derived from gabbro. It is often locally the dominant shrub. In a representative 0.1 ha plot it covered ca. 63% of the area and occurred with *Quercus vaccinifolia* Huckleberry Oak, *Arctostaphylos nevadensis* Pinemat Manzanita, *A. patula* Greenleaf Manzanita, and *Ceanothus prostratus* Squaw Carpet. Common herbs and grasses associated with this species include *Arabis platysperma* Broad-seeded Rock-cress, *Aster brickellioides* var. *glabratus* Siskiyou Rayless Aster, *Eriogonum umbellatum* var. *umbellatum* Sulphur-flowered Buckwheat, *Juncus parryi* Parry's Rush, *Penstemon rupicola* × ?



Nascent inflorescence.



Bark, leaves, and fruit.

Fig. 1. Arctostaphylos klamathensis *sp. nov. Specimens bearing leaves in lower part of size range. Lower cutting from shrub with some leaf tips apiculate. Twice actual sizes. (Scale bar equals 1 centimeter.)*

Rock Penstemon, *Sedum obtusatum* ssp. *boreale* Northern Stonecrop, and *Sitanion jubatum* Big Squirrel-tail. This Klamath Manzanita grows mostly commonly on northeast- and east-facing slopes, but also occurs on northwest-facing slopes just north of Terrace Lake.

RELATIONSHIPS

Arctostaphylos klamathensis stands out instantly from the two locally associated manzanitas, *A. nevadensis* and *A. patula*, by virtue of the unmistakable grayness of its leaves, those of both the other species being dark-green. This first impression of difference is then deepened by the remarkable viscidity of the branchlets of *A. klamathensis*—a character it could not have inherited from either *A. nevadensis* or *A. patula*—and by the intermediate size and shape of its leaves. Although in leaf size and shape *A. klamathensis* stands closer to *A. nevadensis* than to *A. patula*, its leaves are more often mucronate than apiculate like those of *A. nevadensis*. As to habit, it is mat-forming like *A. nevadensis* although twice as tall. There is no burl.

The habit, leaf shapes, and compact inflorescences of *A. klamathensis* are similar to those of *A. knightii*, which occurs at French Camp, Humboldt County, about 119 airline km westward. *A. klamathensis* also resembles *A. nevadensis* to some degree in the same characters (that it does so in the first two respects has already been noted), as well as in features of the seed and fruit. The glandulosity

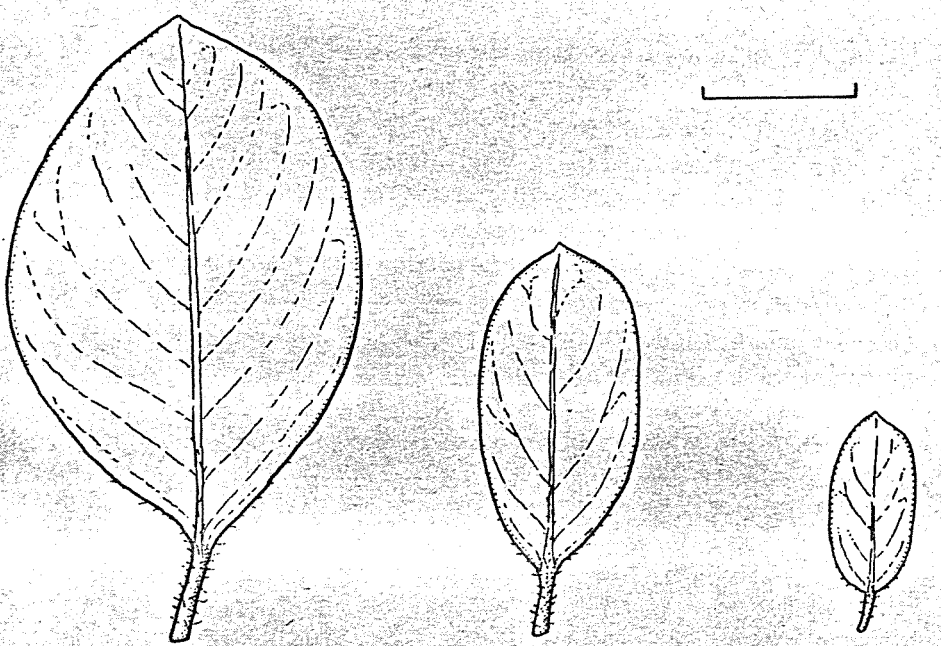


Fig. 2. Three leaves of Arctostaphylos klamathensis *sp. nov. showing part of range of variation in leaf size and shape. Twice actual sizes. (Scale bar equals 1 centimeter.)*

and glaucousness it may have inherited from nearby *A. viscida*, about 10 airline km southward near Dunsmuir. In this area *A. viscida* does not approach 2000 m elevation although it may have done so under different climatic conditions. If hybridization *did* occur, it must have done so very long ago, for the population of *A. klamathensis* is large and remarkably stable in the known locality.

Although the new manzanita was not in bloom on September 19 and October 5, 1982, mature and immature fruits and nascent inflorescences were observed. Because the range needs to be surveyed further, this is but a preliminary report with respect to distribution, although it should be noted that in the area studied thus far, we found no shrubs intermediate between *A. klamathensis* and its green-leaved congeners.

ARCTOSTAPHYLOS KLAMATHENSIS EDWARDS, KEELER-WOLF, AND KNIGHT, SP. NOV.

Frutex humilis circa 2.5 dm altus; tumore lignoso basalare nullo; ramis repentibus et radicantibus; ramulis et petiolis pubescentibus capillis glandulosis; petiolis 4–7 mm longis; laminis plerumque late ellipticis vel obovatis, apice plerumque mucronatis, circa 2.6 cm longis, 1.3 cm latis, glaucis et glabris vel ad basim paucis capillis glandulosis, stomatibus aequalibus supra et infra; inflorescentia compacta, pedicellis ad 6 mm longis capillis glandulosis, bracteis subulatis ad 4.5 mm longis capillis glandulosis, rhachidibus capillis glandulosis, lobis calycis glabris integris; fructibus globosis usque ad 6.5 mm diametro, glabris; seminibus coalescentibus.

Without basal burl; decumbent spreading repent branches rooting along ground, ca. 1–5.5 dm tall, average 2.5 dm tall; petioles and branchlets glandular-setulose, petioles 4–7 mm long; blades glabrous above and below except usually slightly glandular-hairy on margins near base and sometimes on primary vein above and below, glaucous above and below, with stomata numerous and equal above and below, usually mucronate, shapes variable ranging from narrowly oblanceolate through obovate-elliptic to broadly elliptic, to 3 cm long, 2.2 cm wide, averaging ca. 2.6 cm long, 1.3 cm wide; inflorescence compact, few-flowered, pedicels not recurving in fruit, to 6 mm long, bracts subulate and to 4.5 mm long, calyces eglandular, papery, entire; fruit globose, smooth, nutlets fused but separable on impact, to 6.5 mm diameter, stone rugose. Figures 1 and 2.

HOLOTYPE: USA, California, Siskiyou Co., 1884 m elevation on trail between Cliff Lake and Terrace Lake, T39N R5E Section 31, Shasta-Trinity National Forest, *Keeler-Wolf 685* (CAS).

PARATYPES: Edge of Terrace Lake, Siskiyou Co., California, ca. 1898 m, *Edwards & Whipple* (CM, CAS, DAV, UC, JEPS); SWE–82–20. *Keeler-Wolf 686* (JEPS), same location as type.

ETYMOLOGY: *klamathensis* refers to the Klamath Mountains physiographic-geologic province, of which the Trinity Mountains west of Mt. Shasta City are a part.

Additional Vegetation Plot Information

Plot description: 50 × 20 m with long axis facing downhill to ESE. Slope 5–20 degrees. Soil shallow, rocky, with some small boulders and low outcrops. Elevation 1950 m.

Trees	No. of Individuals over 2 m dia. height	Total Basal Area
Abies magnifica var. *shastensis*	21	2393 cm²
Pinus contorta ssp. *murrayana*	24	1990 cm²
Pinus monticola	14	873 cm²
Shrubs		**Est. Cover**
Arctostaphylos klamathensis		63%
Quercus vaccinifolia		9%
A. nevadensis		6%
A. patula		3%
Ceanothus prostratus		2%

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